Report on Field Samples and Data Collected by the Aquaculture Monitoring Program in Maritimes Region, 2024

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Report on Field Samples and Data Collected by the Aquaculture Monitoring Program in Maritimes Region, 2024

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ABSTRACT

Chu, J.W.F., Neil, S., Wong, D., Johnson, L., Jonah, L., Goodwin, C., Hamoutene, D. 2026. Report on Field Samples and Data Collected by the Aquaculture Monitoring Program in Maritimes Region, 2024. Can. Dat. Rep. Fish. Aquat. Sci. 1488: vi + 50 p.

The Aquaculture Monitoring Program (AMP) is a national Fisheries and Oceans Canada (DFO) program initiated in 2017 to detect and quantify chemical and biological parameters in far-field areas neighboring aquaculture finfish and shellfish sites in Canada and to track changes in these parameters over the long-term. This report outlines sampling methods, design, and data resulting from field surveys of finfish aquaculture sites done by DFO's Maritimes region in 2024. During these trips, AMP sampling protocols were used to survey three sites: AMP site F09 in May, site F04 in July, and site F10 in August. Surveys followed the two-dimensional, distance-stratified grid of sampling stations as standardized for AMP finfish site surveys. Across all surveys, 119 stations were sampled for sediment grain size, drugs, pesticides, antibiotics, trace metals, and total organic content. Total dissolved sulfides in sediment porewater were also measured in all stations using three methods (ISE, UV, and methylene blue). Thirty sediment grabs were collected each at site F04 and F10 (60 total) for characterization of benthic macrofauna communities in July and August respectively. Additional sampling that AMP facilitated in support of external collaborative research projects are also briefly described.

RÉSUMÉ

Chu, J.W.F., Neil, S., Wong, D., Johnson, L., Jonah, L., Goodwin, C. Hamoutene, D. 2026. Report on Field Samples and Data Collected by the Aquaculture Monitoring Program in Maritimes Region, 2024. Can. Dat. Rep. Fish. Aquat. Sci. 1488: vi + 50 p.

Le Programme de surveillance de l'aquaculture (PSA) est un programme national du MPO initié en 2017 pour collecter et analyser des données permettant de caractériser les effets potentiels en champ lointain de la pisciculture et de la conchyliculture côtière au Canada. Le présent rapport présente les méthodes et le plan d'échantillonnage mis en œuvre en 2024 par la région des Maritimes du MPO sur un site d'aquaculture de poissons, ainsi que les données recueillies. Lors de ces voyages, les protocoles d'échantillonnage du PSA ont été utilisés pour enquêter à deux sites: le site F09 du PSA en mai, le site F04 en juillet, et le site F10 en août. Les enquêtes ont été menées à des stations d'échantillonnage distribuées selon la grille bidimensionnelle et stratifiée en distance préétablie pour le programme. Sur l'ensemble des enquêtes, 119 stations ont été échantillonnées pour la granulométrie des sédiments, les médicaments, les pesticides, les antibiotiques, les métaux traces, et la teneur totale en matières organiques. Les sulfures totaux dissous dans l'eau interstitielle des sédiments ont également été mesurés à toutes les stations à l'aide de trois méthodes (ISE, UV et bleu de méthylène).Trente prélèvements de sédiments ont été effectués sur les site F04 et F10 (60 au total) pour la caractérisation des communautés benthiques de macrofaune en juillet et en août respectivement. Des échantillonnages supplémentaires facilités par PSA, en appui à des projets de recherche collaboratifs externes, sont également brièvement décrits.

1 INTRODUCTION

1.1 THE AQUACULTURE MONITORING PROGRAM (AMP)

AMP assesses the far-field effects of Canadian finfish and shellfish aquaculture in coastal environments. Sampling activities are carried out by independent regional programs in the Maritimes, Newfoundland and Labrador, Gulf, Quebec and Pacific regions, based on the types of coastal aquaculture production present. AMP aims to provides data and analyses that contribute to research and science advice guiding policies, regulations, and decisions supporting that sustainable aquaculture management. Monitoring involves data collection from areas of marine aquaculture production along the Atlantic and Pacific coasts of Canada, with the goals of detecting and quantifying chemical and biological changes in far-field areas near aquaculture sites and tracking long-term shifts in these parameters (i.e., >10 years). AMP involves regularly visiting specific aquaculture sites while applying a consistent approach for sampling and laboratory analysis, where feasible. Field sampling is conducted to generate data for several benthic, pelagic, and oceanographic parameters. Benthic parameter data are collected at all sites, pelagic parameter data are collected at shellfish sites, and oceanographic data are collected in select locations.

1.2 PURPOSE OF THIS REPORT

Annual data reports are published to provide an overview of AMP activities and are intended to be used as a companion source for end-users of the data. This report includes:

1) A description of sampling efforts, methodology, and processing used by the Maritimes region program during the 2024 field season.
2) An overview of the data obtained, including descriptive statistics that are relevant to the program objectives.

1.3 SUMMARY OF AMP MARITIMES REGION SCIENCE FOR 2024

1.3.1 SCIENCE ACTIVITIES COMPLETED AS PART OF STANDARD AMP SAMPLING PROTOCOLS

In 2024, fieldwork was completed in the late spring and summer at finfish aquaculture farms (here after referred to as ‘sites’) in coastal New Brunswick. During these surveys, AMP benthic sampling protocols were applied at site F09 in May, F04 in July, and F10 in August. Sampling followed the standardized two-dimensional grid of stations previously established in 2022 for F09. A previously drafted grid of stations for F04 (established in 2019) was modified to optimize placement of sampling stations relative to the situational reality at F04. A new standardized survey grid was established for F10, which was surveyed for the first time as a new AMP site in 2024.

Across all finfish sites and sampling trips, 119 stations were sampled using AMP standardized protocols (Table 1). Samples were collected for sediment grain size (SGS), drugs, pesticides, and antibiotics (DPABs), trace metals and organic content (TM & OM), and total dissolved sulfide (TDS) measured using three methods: the ion selective electrode (ISE), ultraviolet absorbance (UV), and methylene blue reaction (MB) methods.

30 stations for quantifying benthic macrofauna were also sampled at each of F04 and F10 (60 total) as part of a new Competitive Science Research Fund project (hereafter “the CSRF project”) aimed at assessing the effects of chemicals and organic matter enrichment. The CSRF work and budget were approved without first consulting with the AMP Maritimes staff. As a result, AMP

Maritimes absorbed 60% of the CSRF project field deliverables in addition to the standard work deliverables, which required a modification of the AMP workplan midway through the active field season with a committed of shifting field sites for two years in order for the CSRF project to be successful. The extensive survey plan, methods, sampling, and results presented in this report reflect the major, non-standard work requirements and delivery that were developed by the AMP Maritimes staff and their multi-year commitment to prioritizing CSRF for the first two years of this project while staying accountable to national AMP objectives.

1.3.2 ADDITIONAL SCIENCE ACTIVITIES SUPPORTED BY AMP

While only core AMP field component data are summarizes in this data report, additional data collection and science that (1) informs on AMP objectives or (2) leveraged AMP resources (staff, funding, assets) were also completed through collaboration with the AMP operational field program. In general, sampling for these projects does not follow standardized protocols, with downstream data curation and analyses being led by the external program leads, and are not summarized here.

Sediment samples were collected at site F04 and F10 to support an ongoing molecular biology research focused on antimicrobial resistance genes (AMR), co-led by Drs. D. Hamoutene and L. Johnson of DFO-SABS and Derek Smith of Environment and Climate Change Canada (ECCC). Sediment was sub-sampled from six benthic grabs at F04 and five grabs at F10, and collected following protocols previously provided by the external collaborators (see Johnson et al. 2025).

Additional sampling was also conducted during the August survey at site F10 and at a non-AMP site in aquaculture bay management area 2a on November 9 in support of an ongoing Canadian Science Advisory Secretariat (CSAS) effort to develop and assess alternative total dissolved sulfide methods (UV, MB) led by D. Wong and Dr. Fred Page (DFO 2026), and to develop a pilot study for measuring dissolved oxygen in the sediment pore waters led, by Dr. J Chu for the 2025 field season.

2 METHODOLOGY

2.1 FIELD SURVEY LOGISTICS

Standard AMP field sample and data collection occurred during May 22–24 at site F09, July 15–19 at site F04, and August 12–16 at site F10. Only finfish sites in coastal New Brunswick were surveyed in 2024.

Site selection for AMP benthic surveys requires balancing multiple criteria. Ideally, sites have historical surveys that could inform long-term monitoring objectives, occur in areas with high finfish aquaculture production, have a history of DFO science data collection, and are adjacent to other ongoing DFO research programs, thereby increasing the likelihood of data reusability. Sites are also ideally located in relatively shallow waters (<30 m) with predominantly muddy-soft sediments that allow samples to be collected by both benthic grabs and cores (HAPS corer and divers).

Site F09 was identified as a potential long-term AMP monitoring site in 2022, surveyed completely in 2022, and surveyed partially in 2023 (Chu et al. 2025a). Sampling stations here are shallow (<18 m average depth) with a patchy mixture of soft-mud bottoms, gravel, and cobble. Sampling was prioritized to coincide with the end of the three-year production cycle, as fish were removed weeks prior to the AMP survey in 2024.

To align operational requirements with the shift in priorities on account of the short-term requests of the CSRF project (2024–2026), two sites were selected halfway through the field season to maximize the potential for successful sampling and delivery of the large sample sizes required for the core AMP benthic parameters in the CSRF project. A list of leases put forth to Introductions and Transfers as requests for stocking new fish was acquired (L. Brager, pers. comm.). All leases accessible by small vessel launched out of SABS were visited on July 4, 2024, to visually confirm production status, map cage positions, and assess general suitability for AMP benthic sampling methods. For active leases, the coordinates representing the corners of the polygon that would capture the cage array footprint were mapped using the GPS vessel plotter.

With operational feasibility in mind, site F04 (a previously surveyed AMP site) and F10 (a new site to AMP) were chosen to balance the standard site characteristic priorities described above with (1) short-term priorities of the large sample sizes associated with the macrofauna objectives of the CSRF project and the need for sampling benthic tracers in parallel, (2) geographic and operational realities of surveying the sites using AMP benthic protocols, and (3) realigning the data products of the AMP Maritimes operational program while still maintaining the integrity of the long-term monitoring objectives.

2.2 FINFISH SITES

2.2.1 SITE F09

Sampling stations (n=66) at F09 were previously established in 2022 using the distance-stratified grid designed for a single target lease (see Chu et al. 2025b for details). This single-lease design ignores the existence of adjacent leases, as it was originally designed at a single, geographically isolated site in Pacific region and requires iterative modification to be applicable elsewhere (Chu et al. 2025 a,b).

Of the n=66 stations established in 2022 and planned for sampling in 2024, n=40 were successfully sampled for AMP benthic tracers (Fig. 1). Unsuccessful stations were the result of

a lack of soft sediment and station inaccessibility — e.g. too close to shore for the science vessel and the presence of other boat traffic during sampling days (Fig. 1).

2.2.2 SITE F04

This site is located in an area with relatively high finfish aquaculture production, with two leases (hereafter referred to as F04a and F04b) simultaneously having active production. The initial grid created in 2019 at F04a (hereby referred to as the historical grid) was directly transposed from the single-lease design established in Pacific region to this site without modification (see Chu et al. 2025b for Pacific grid design). As a result, the historical grid did not account for the proximate second lease and was not optimally designed to resolve the effects of activity at F04b.

In 2024, active production cages were only present at F04b, which required modification of the historical grid. Stations that were unsuccessfully sampled due to lack of soft substratum were identified in the 2019-2022 historical grid datasets and removed from the grid, cage edge stations were added to F04b, and the spatial distribution of n=55 stations was rebalanced to enable the potential near-field to far-field gradient of aquaculture effects to be captured at F04b.

Of the n=55 attempted stations, n=47 were successfully sampled for AMP benthic tracers, and n=30 of those successful stations were also sampled for macrofauna community characterization in parallel with the benthic tracers (Fig. 2). Unsuccessful stations were mostly newly plotted stations (station numbers >55) and stations with a history of low sediment occurrence (station numbers <55).

2.2.3 SITE F10

Prior to this survey, no practical research was devoted to developing scientific advice that could be used to operationally inform the establishment of new survey grids factoring in the geographic footprint of leases in the Maritimes region. As noted for F04 above, the draft documents from 2019 presented only an extrapolation of the single isolated lease in Pacific region without situational considerations to the Maritimes setting (see Chu et al. 2025a,b). The historical transposing of the Pacific design to the Maritimes region has resulted in challenges with site-based realities unknown availability of soft substratum for benthic sampling (e.g. as described for F04 above and in Chu et al. 2025a).

For F10, a general field protocol for grid development and iterative refinement within a single field season was used. The approach started with a standard n=55 station approach following the draft protocols for isolated single sites in Pacific region (Chu et al. 2025b), which was appended with the site-specific considerations and modifications to adapt the grid to sites elsewhere (e.g. as described for F04 above and in Chu et al. 2025a). Strategic sampling of planned stations was used to identify general areas of unsuitable (hard) substratum during the first two days of field surveys. When generally unsuitable areas were identified, additional stations were plotted to maximize potential coverage over areas of soft substratum area surrounding the lease while avoiding remaining stations in unsuitable areas.

In total, n=87 stations were generated for this new site; sampling was attempted at n=50 stations, n=32 stations were successfully sampled for AMP benthic tracers, and n=30 of those successful stations were also sampled for macrofauna community characterization in parallel with the benthic tracers (Fig. 3). The set of n=32 stations maximizes coverage of the area that can be surveyed at this site after incorporating site-specific characteristics of the target lease (Fig. 3).

2.3 SHELLFISH SITES

No shellfish aquaculture sites were surveyed by AMP Maritimes region in 2024.

2.4 VESSEL USED FOR SAMPLING

For the May survey at site F09, benthic sampling was done onboard the Canadian Coast Guard Vessel Viola M. Davidson (CCGS VMD, 18 m length, hull width 5.2 m, 59.4 gross tonnes specialty research vessel). For the surveys at site F04 and F10, benthic sampling was done onboard the Salar, a Rosborough 246 (7.62m length, 2.59m beam, ~6.5 tonnes) powered by twin 225HP outboard motors.

2.4.1 BENTHIC SAMPLING

Benthic sampling and processing of sediment followed standardized AMP protocols except as noted below.

Sampling at F09 was done with a 100 kg HAPS corer (KC Denmark A/S) with 4 L shock-proof polycarbonate core tubes (31.5 cm length, 12.7 cm internal diameter). The HAPS corer was deployed and recovered using a crane and hydraulic winch on the aft deck of the CCGS VMD. Sampling at F04 and F10 was conducted with a standard Ponar bottom grab (23 cm x 23 cm, 23 kg weight, 8.2 L capacity). A rope was attached to the grab using a shackle and run through a block suspended from the davit mounted on the starboard aft deck of the Salar. The grab was deployed manually by hand to control the rate of descent and retrieved using an electric winch. A custom wooden landing platform was temporarily mounted to the starboard aft deck for manipulating the grab between deployments.

When the corer/grab reached bottom at a station, sampling time, bottom depth, latitude and longitude were recorded from the ship navigation and depth sounder. When a successful core was recovered on deck, it was transferred to a stand and the core was pushed upwards to process sediment from the sediment-water interface. When a grab was successfully recovered, it was landed onto the wooden landing platform for stability during sediment subsampling.

Qualitative sample characteristics for each core/grab were recorded on a datasheet along with measurements of sediment temperature from a digital thermometer inserted into the top 2 cm of the sediment core. The upper 2 cm of sediment from each core/grab was processed into separate jars pre-assigned for (1) sediment grain size, (2) drugs, pesticides, and antibiotics, and (3) trace metals and organic matter. 5 mL plastic syringes were used to collect surface sediment for total dissolved sulfide (TDS) analyses using the ISE method. Sediment porewater was also collected from the sediment for TDS analyses following standardized protocols for the UV sulfide and methylene blue sulfide methods. Further details on parameter-specific processing protocols are described below. Sediment-filled jars are placed in coolers with ice before being transferred to -20°C storage at the St. Andrews Biological Station (SABS) within hours after sampling. Within hours of sampling, TDS samples for ISE analyses are performed at SABS. Samples that are shipped to external labs were shipped using priority overnight couriers, on ice, and arrived at their respective external labs within 48 h of leaving SABS, with confirmation of receipt.

A second grab is collected immediately alongside the first grab at stations pre-selected for benthic macrofauna sampling; one grab is processed for benthic tracers and the entire contents of the second grab is retained for macrofauna characterization. For macrofauna sampling in 2024, stations were selected to cover the range of distances from active farm cages. The sediment from the macrofauna grabs was temporarily stored in buckets with lids while on the vessel, immediately

transported back to SABS, and sieved through a 0.5 mm mesh within hours of sampling. Retained macrofauna were fixed in 1-2 L high-density, polyethylene sampling jars using 10% buffered formalin and delivered to the Huntsman Marine Science Centre (HMSC, Saint Andrews, NB) within a week of sampling.

2.4.2 PELAGIC SAMPLING

AMP pelagic sampling protocols (water, CTD profiles, zooplankton) were not used in 2024.

2.5 LAB ANALYSES

2.5.1 SAMPLE PREPARATION

Physical samples requiring external science services for analyses were kept in -20°C storage at SABS until procurement paperwork could be completed. Prior to the confirmed shipping date, frozen samples (DPAB, TM & OM) were briefly removed from the freezer to be packaged in padded shipment coolers (U-Line P/N S18968) with frozen ice packs and returned to the freezer. Courier pickup was arranged for the following day, and packaged frozen samples were brought out the morning of pickup for next-day delivery.

2.5.2 SEDIMENT GRAIN SIZE (SGS)

As of 2024, there is a SGS sample processing backlog at SABS as the AMP Maritimes operational program subsidizes national SGS sample analysis for all AMP regions. Prior to 2021, the AMP national working group advised the program to invest in a Beckman-Coulter LS 13320 diffraction laser particle size analyzer to process SGS samples. More recently, the AMP national working group advised SGS analyses shift to using a Beckman-Coulter Multisizer 4e Coulter Counter (Milligan et al. 2025). The logistics and work planning to incorporate and reconcile these pieces of advice, with the goal developing a sustainable in-house lab to subsidize the processing of all national SGS samples within the AMP Maritime program, began in 2024 and remain a work in progress.

Currently, each AMP SGS sample is analyzed through a 30 µm, 200 µm, and 400 µm aperture tube to resolve a total particle size range of 1 to 296 µm using the Multisizer 4e. Following Milligan and Law (2005) and McCave et al. (1995), samples are thawed in a 4°C fridge and then chemically pretreated with 30% hydrogen peroxide (H_2O_2) to remove organic carbon from the sediment. Each SGS sample is homogenized, and a 0.1-0.2 g subsample is placed into a glass beaker (10 to 50 mL). Two to three mL of 30% H_2O_2 is added to each subsample and then dried on a hot plate at 60ºC. This step is repeated until no further bubbling occurs with the addition of H_2O_2.

A subset (n=60) of the SGS samples collected were shipped to B. Law for analyses as part of the short-term needs of the CSRF project deliverables. These samples were processed by Brent Law and Vanessa Zions and followed their in-house protocols (see. Milligan et al. 2025).

2.5.3 DRUGS, PESTICIDES, AND ANTIBIOTICS (DPAB)

DPAB samples were shipped to MB Laboratories (MB Labs, Sidney, BC) for analysis.

General methodological details on the sample preparation and analyses used by MB Labs were first described by Chu et al. (2025b) for the 2022 field season in AMP Pacific region and Chu et al. (2025a) for the 2023 field season in AMP Maritimes region.

MB Labs developed, validated, and uses two in-house extraction methods for measuring a suite of DPABs in sediment samples. The first is a modified QuEChERS method is used for measuring Abamectin, Azamethiphos, Cypermethrin, Deltamethrin, Erythromycin-H20, Desmethyl emamectin benzoate, Emamectin, Florfenicol, Ivermectin, Lufenuron, Sulfadimethoxine, Sulfadiazine, Teflubenzuron, and Trimethoprim in samples. Here, moisture content is first measured as the mass lost from oven-drying sediment samples at 60°C. Sediment samples (~5 g) are then weighed into 50 mL centrifuge tubes and spiked with either a four-compound surrogate mix or a 14-compound mix. High Performance Liquid Chromatography (HPLC) grade water (5 mL) is then pipetted into each sample followed by acetonitrile (10 mL). The tubes are then vortexed and shaken for 1 min and then allowed to stand for 5 min. QuEChERS extraction salts (1.5 g anhydrous sodium acetate and 6 g magnesium sulfate) are added, then vortexed again for 1.5 min, followed by centrifugation for 5 min at 4100 rpm. The supernatants are immediately decanted into fresh 50 mL centrifuge tubes. Aliquots (1 mL) of supernatant are pipetted into a dSPE tube containing 150 mg magnesium sulfate and 50 mg C18 sorbent. Internal standards are added, tubes are capped and then vortexed for 1 min followed by centrifugation at 4100 rpm for 5 min. The supernatant is then filtered through a 0.2 µm nylon filter into a 2 mL LC vial for LC-MS/MS analysis. The second in-house method uses a buffer extraction to measure Amoxicillin and Oxytetracyline in samples which cannot be sufficiently recovered using the modified QuEChERS method. Sediment samples (~3 g) are first weighed into 50 mL centrifuges tubes. For spiked samples, a mix of amoxicillin and oxytetracycline is used. EDTA-McIlvaine buffer (10 mL) is added to each sample which is hand-shaken for 1 min, followed by mechanical shaking for 30 min. Samples are then centrifuged for 5 min at 4100 rpm. 5 mL aliquots of the supernatant are filtered into glass tubes through 0.2 µm nylon filters then 1 mL of each transferred into LC vials. Thiacloprid, used as internal control, is spiked into each vial then capped and mixed for 1 min prior to LC-MS/MS analysis. All analysis were performed using a Waters ACQUITY UPLC coupled to a Waters Xevo TQ-S triple quadrupole mass spectrometer following in-house calibrated settings.

AMP samples analyzed by MB Labs for DPAB detection can result in values below method detection limits (MDL) and below levels of quantification (LOQ). The quantitative definition MB Labs provides for calculating their MDL and LOQ values are as follows: first, the lower theoretical value for a given method is calculated as the standard deviation of the zero-analyte concentration (S_o). If a compound is detected above the S_o but below the MDL, verification is used to confirm that the values are real. MDL values are defined as the statistical estimate of a value that is accepted as real without additional verification; an example calculation would be estimating MDL as $3*S_o$. LOQ threshold values are statistical estimates for the concentration of the analyte where concentrations above the LOQ are considered statistically accurate; an example calculation of LOQ would be 10*MDL. MB Labs has conducted internal quality control and quality assurance to independently establish S_o, MBL, and LOQ values reported in their delivered datasets (W. Riggs, MB Labs, pers comm.).

2.5.4 TRACE METALS AND TOTAL ORGANIC MATTER (TM & OM)

TM & OM samples were shipped to the New Brunswick Research and Productivity Council (RPC, Fredericton, NB) for analysis.

General details on the lab methods used by RPC for TM & OM sample analyses were first described by Chu et al. for the 2022 field season in AMP Pacific region (Chu et al. 2025b) and 2023 field season in AMP Maritimes region (Chu et al. 2025a).

RPC performed trace metal analysis following protocols of the United States Environmental Protect Agency (EPA) method 3050B for acid digestion of sediments, sludges, and soils (US EPA, 1996). Samples are digested with repeated additions of nitric acid (HNO_3) and H_2O_2 before adding hydrochloric acid (HCl). In an optional step to increase the solubility of some metals, the digestate is filtered and the filter paper and residues are rinsed with hot HCl and then hot reagent water. Filter paper and residue are returned to the digestion flask, refluxed with additional HCl and then filtered again. The digestate is diluted to a final volume of 100 mL. After digestion, samples are analyzed using inductively coupled plasma atomic emission spectrometry.

Performance Testing of samples is regularly completed by RPC through the Canadian Association Laboratory Accreditation. For quality control, a method blank is completed throughout the entire sample preparation and analytical process for each batch of samples processed. Spiked duplicate samples are also processed on a routine basis whenever a new sample matrix is being analyzed. The full suite of trace-elements analyzed by RPC included: Aluminum (Al), Antimony (Sb), Arsenic (As), Barium (Ba), Beryllium (Be), Bismuth (Bi), Boron (B), Cadmium (Cd), Calcium (Ca), Chromium (Cr), Cobalt (Co), Copper (Cu), Iron (Fe), Lead (Pb), Lithium (Li), Magnesium (Mg), Manganese (Mn), Mercury (Hg), Molybdenum (Mo), Nickel (Ni), Potassium (K), Rubidium (Rb), Selenium (Se), Silver (Ag), Sodium (Na), Strontium (Sr), Tellurium (Te), Thallium (Tl), Tin (Sn), Uranium (U), Vanadium (V), and Zinc (Zn) several of which can be used as tracers of aquaculture activities (e.g., Naylor et al., 1999; Smith et al., 2005; Sutherland et al., 2007; Sutherland and Yeats, 2011; Yeats et al., 2005), and their known conservative properties for normalization processes (e.g., Daskalakis and O'Connor,1995; Grant and Middleton, 1990; Loring and Rantala, 1992; Matthai and Birch, 2001).

Total organic matter (%) is quantified as the sample fraction that is lost on ignition (ASTM Standard, 1993). In brief, ash content (inorganic content) of a sediment sample is determined by placing a 60°C oven-dried sample into a muffle furnace and gradually bringing the temperature in the furnace to 440°C. Then the temperature is held at 440°C until the specimen is completely ashed, with no mass change occurring after additional heating.

The AMP national working group identified Cadmium, Copper, Molybdenum, Uranium, and Zinc as the most informative subset of TMs of interest for summary in the annual data reporting done by each AMP region. This subset was identified as possible tracers of anthropogenic enrichment following a regionally pooled analysis of past AMP samples identified their potential to be normalized with Lithium (Kingsbury et al. 2023). TM subsets were analyzed following the authors' advised procedures for geochemical normalization (Sutherland et al. 2007; Sutherland and Yeats 2011; Hamoutene et al. 2021). Within the samples collected at a site and survey period, stations that were >350 m from the cages (assumed to represent background / reference levels) of the target finfish farm were used to calculate a linear regression against Lithium. Regressions were calculated for each site while also presenting R^2 values to indicate the goodness of fit. Stations that had values greater than the 95% confidence interval of the regression against Li can be interpreted as enriched (Sutherland et al. 2007; Sutherland and Yeats 2011; Hamoutene et al. 2021) but only if the assumption of linearity is met (i.e., high R^2 value).

2.5.5 SEDIMENT TOTAL DISSOLVED SULFIDE (TDS)

General details on how AMP Maritimes generates data using each of three methods used to quantify total dissolved sulfide (TDS) were first described in Chu et al. 2025a. The ion selective

electrode (ISE), ultraviolet absorbance (UV), and methylene blue reaction (MB) methods (Wildish et al 1999, 2004; Cranford et al. 2020; Cranford 2024) were used to quantify TDS in 2024.

While each sediment core/grab was still on the vessel deck, one 5 mL syringe of sediment was taken from the upper 2 cm of the undisturbed core/grab, wrapped in Parafilm®, and placed in a cooler with ice. These sediment-filled syringes are were analyzed back at SABS using the ISE method within hours of sampling. Concurrently with the sampling for ISE, a spring syringe with a three-way valve and a Rhizocera pore-water sampler were also inserted into the top 2 cm of the undisturbed sediment of the core/grab. After 1-3 min, the syringe is removed from the sediment and 100 µL aliquots of pore water are extracted using a gas-tight syringe for both the UV and MB methods.

The porewater for the UV method is analyzed immediately on board the sampling vessel. 100 µL of the pore water was mixed with 1 mL of pH-adjusted distilled water in a Hellma Suprasil quartz cuvette. Absorbance was measured at wavelengths of 230, 240, and 250 nm using an Implens C40 spectrophotometer. TDS concentration was calculated from the 230 nm absorbance readings using a standard curve created from serial dilutions from a reference sulfide sample prepared at SABS by D. Wong. For the MB method, a second 100 µL aliquot of porewater is added to lab-prepared microcentrifuge tubes containing 1 mL of a fixative solution (zinc acetate:EDTA: sodium hydroxide, 1:1:0.8%, w/v), capped, shaken, are stored in a ice-filled cooler until analyzed back at SABS. A stock solution of zinc acetate:EDTA:NaOH was created at SABS the day leading into each field sampling trip.

Lab-based analyses of samples collected for the ISE and MB methods were conducted back at SABS. For the ISE method, samples were analyzed on the same day and within hours of field sampling. ISE samples were removed from the cooler and transferred to 4°C storage. For ISE analysis, each the sediment sampled in each 5 mL syringe is added to a 5 mL solution of alkaline EDTA solution containing L-ascorbic acid (sulfide antioxidant buffer – SAOB) then stirred using a glass rod to obtain a homogenous sample. A calibrated ISE probe (100 to 10,000 µM, Thermo Scientific Orion Silver/sulfide ionplus® Sure-Flow solid state combination ISE) with a temperature compensation sensor (Fisher Scientific Accumet automatic temperature compensation probe) attached to an AP125 portable meter (Fisher Scientific Accumet AP125 portable pH/ion/mV/temperature meter) was then inserted into the homogenized sample and sulfide content determined once the mV reading stabilized, or to a maximum measurement period of 2 min. For the MB method, samples were analyzed at a later date. During MB sample processing, TDS was determined by adding acidic solutions of N,N-dimethyl-p-phenylenediamine dihydrochloride and iron (III) chloride hexahydrate, which react with the sulfide to form methylene blue. The absorbance of the produced methylene blue was determined at a wavelength of 660 nm. Sulfide concentrations were then calculated against a prepared calibration curve.

2.5.6 SEDIMENT MACROFAUNA

At HMSC, formalin-fixed samples were transferred into 70% ethanol before being sorted by trained personnel for taxonomic identification and enumeration. Where possible, whole samples were sorted; where this fell outside of the allowed per-sample time frame, smaller fractions were sorted and organism counts were multiplied to calculate an abundance per total sample. For example, sample counts for a quarter subsample were multiplied by four to generate a whole-sample abundance value for analysis.

All organisms were identified using dissecting (10-40x magnification) and/or compound (100-1000x) microscopes and standard taxonomic keys to the lower possible taxonomic level.

Specimens were identified to species level where possible. To control for the potential influence of newly trained sorters, whole or partial subsamples sorted by new technicians were re-sorted by a trained technician to ensure a sorting efficiency of >95% for all samples. If any samples fell below 95% sorting efficiency, they were re-sorted in their entirety. Identifications of new technicians were also checked for consistency.

For some specimens, genus or higher classifications are required. For example, nemerteans can lose identifying characteristics after fixation, and some local species are also undescribed. For such specimens, interim names are used (e.g. *Ampharete sp.* A, *Parougia* nr *eliasoni*) and they represent unique operational taxonomic units (OTUs). When identification is generally not possible past genus level, 'spp.' is used (e.g. *Cerebratulus* spp.), indicating that the specimen could belong to one of several species of *Cerebratulus* present in the region, and may represent more than one OTU. When identification is not possible due to specimen-specific reasons, such as damage or immaturity, the epithet 'sp. (juv/dam)' is used (e.g. *Nereis* sp. (juv/dam)). In cases where genetics are required to separate species, two names are listed (e.g. *Mytilus edulis/trossulus*). Valid taxonomy was cross-referenced and updated with the World Register of Marine Species (WoRMS Editorial Board, 2025). Specimens and debris were not retained, but a reference collection for the project is maintained where any new species identified are deposited.

An expanded taxonomy of each OTU identified and the counts relative to samples from F04 and F10 are presented. Abundances were used to summarize basic macrofauna diversity patterns using three standard biodiversity indices. Using the OTUs and their respective abundances, Hill numbers formulations (Hill 1973) were used to calculate species richness (N_0), the Shannon diversity index (N_1) and the Simpsons diversity index (N_2). The Hill numbers version of these indices use the same units (equivalent number of species) and inform on number of unique species, abundant species, and dominant species respectively (Borcard et al. 2011). To assess the species richness captured by the sampling effort, abundance data was used to generate a sample-based species accumulation curve (n=500 permutations) with extrapolated species richness calculated using the Chao estimator (O'Hara 2005).

2.5.7 SESTON

NA for Maritimes region in 2024.

2.5.8 ELEMENTAL CARBON AND NITROGEN

NA for Maritimes region in 2024.

2.5.9 CHLOROPHYLL

NA for Maritimes region in 2024.

2.5.10 ZOOPLANKTON

NA for Maritimes region in 2024.

2.5.11 OCEANOGRAPHY

NA for Maritimes region in 2024.

2.6 DESCRIPTION OF PRELIMINARY ANALYSES AND PLOTS

These standardized AMP summary analyses and plots were first developed, described, and published for the Pacific region by Chu et al. (2025a) and the Maritimes region by Chu et al. (2025b). Piecewise regressions are used to identify breakpoints in the data for several benthic parameters (DPABs, TDS, macrofauna) as a function of distance from the cages of the target sites. Piecewise regressions fit two linear regressions through a set of data to identify threshold relationships. When applied to data as a function of distance, significant breakpoints can be used to resolve the maximum distance of a parameter's zone of effect relative to the target site. Piecewise regressions were done with the segmented R package (Muggeo 2008). Taxonomic summaries of the macrofauna species data were generated using the worrms R package (Chamberlain 2020). Biodiversity indices and species accumulation curves were calculated using the vegan R package (Oksanen et al. 2013). All data summary, plots, and analyses were done in R 4.3.2 (R Core Team, 2023). Maps were created in ArcGIS Pro 2.9.8 using WGS1984 (ESPG: 4326) and WGS1984 UTM Zone 19N geographic and projected coordinate systems, respectively.

3 RESULTS

3.1 SAMPLING SUMMARY AND DATA AVAILABILITY

A summary of the number of grabs and samples collected in 2024 following standardized AMP benthic protocols is presented in Table 1.The collection effort, number of samples sent to external lab for analyses during the current year, the number of samples returned by the external labs at the time of writing of this report, and additional sampling effort to support other research programs are summarized in Table 2.

Annual AMP Maritimes datasets are submitted to the AMP EQuIS database and the number of samples collected corresponds to the sample sizes in the national EQuIS database. Finalized data files have been formatted by parameter following a standardized set of data columns for migration into EQuIS and are also currently stored on the National Aquaculture Monitoring Program MS Teams channel. Given subsets of these data are currently classified as protected-B information, partial access can be granted on a case-by-case basis through direct request to program leads at National Capital Region.

3.2 SEDIMENT GRAIN SIZE (SGS)

Raw particle counts and dilutions for each sample and aperture tube flow rates analyzed using the Beckman-Coulter Multisizer 4e at SABS are available and can be provided to end-users for analyses. Samples processed by B. Law and V. Zions are summarized following their in-house data protocols and can be made available through the co-leads of the CSRF project.

3.3 DRUGS, PESTICIDES, AND ANTIBIOTICS (DPAB)

Analyzed concentrations of DPABs and their respective lower limits as summarized by station are presented in Table 3.

Of the 17 DPABs of interest, six (Desmethyl EB, Emamectin, Lufeneron, Teflubenzuron, Trimethroprim, Oxytetracycline) were detected in samples collected in 2024.

At site F09, Desmethyl EB was detected at nine stations (min-max: 0.07 to 0.29 ng/g), Emamectin at 31 stations (0.06 to 1.68 ng/g), Lufernuron at nine stations (0.10 to 0.16 ng/g), Teflubenzuron at one station (5.61 ng/g), Trimethroprim at two stations (0.08 to 0.16 ng/g), and Oxytetracycline at 39 stations (0.09 to 140 ng/g).

At site F04, Desmethyl EB was detected at five stations (0.07 to 0.20 ng/g), Emamectin at 13 stations (0.07 to 0.81 ng/g), Lufenuron at eight stations (0.08 to 0.48 ng/g), Teflubenzuron at 12 stations (1.39 to 8.44 ng/g), Trimethroprim at one station (0.15 ng/g), and Oxytetracyclien at 19 stations (0.09 to 5.37 ng/g).

At site F10, Desmethyl EB was detected at one station (0.06 ng/g), Emamectin at nine stations (0.02 to 0.50 ng/g), Lufeneron at 10 stations (0.07 to 1.16 ng/g), Tuflubenzuron at 24 stations (1.28 to 35.3 ng/g), and Oxytetracycline at 31 stations (0.18 to 99.7 ng/g).

Piecewise regressions resolved significant distance break-points among DPAB tracers at F09: 76 m for Emamectin, 64 m for Desmethyl EB, 157 m for Oxytetracycline, and 65 m for Lufeneron (Fig. 4-6, all $p<0.05$). No significant distance breakpoints were resolved for any DPABs detected at site F04 or F10 ($p>0.05$, Fig. 4-9). No significant distance breakpoints were resolved for Teblubenzuron and Trimethroprim at any site ($p>0.05$, Fig. 8-9).

3.4 TRACE METALS AND TOTAL ORGANIC MATTER (TM & OM)

Moisture content, trace metal (TM) concentrations, and total organic content (OM) by site and sampling period are summarized in Table 4 and Fig. 10-16. Unlike MB Labs, RPC does not distinguish values of zero (absence of the parameter) using their internal protocols for reporting lower limits. As a result, absence of a tracer in these data cannot be quantified.

Poor fitting linear models ($R^2 < 0.8$) limit the interpretability of these tracers as indicators of aquaculture activity in the majority of these data (Fig. 11-15). Of the normalized regression fits with relatively higher R^2 values (>0.8), Copper at F09 (maximum distance of an enriched station, dmax = 844m), Zinc at F09 (dmax = 497m), and F10 (dmax = 190m) indicate the potential for enrichment in the far-field zone outside their respective near-field (in-lease) areas (Fig. 12,15). No distance-based relationships were resolved for sample moisture or organic matter content at any site (Fig. 16).

3.5 SEDIMENT TOTAL DISSOLVED SULFIDES (TDS)

A summary of sediment TDS samples as analyzed by each of the ISE, UV, and MB methods is presented in Table 5.

For samples analyzed using the ISE method, 20% (8 of 40), 57% (27 of 47), and 78% (25 of 32) of detections resulted in values registering above the method LOQ (100 µM) at sites F09, F04, and F10, respectively with a maximum of 2180 µM detected at site F10.

For samples analyzed using the UV method, 95% of samples (38 of 40), 96% (45 of 47), and 100% (32 of 32) of detections resulted in values registering above the method LOQ (37 µM) at sites F09, F04, and F10, respectively with a maximum of 856 µM detected at site F10.

For samples analyzed using the MB method, 2.5% (1 of 40) and 3% (1 of 47) of detections resulted in values registering above the method LOQ (200 µM) at sites F09 and F04, respectively, with no samples yielding measurable values above LOQ at site F10. A maximum of 1287 µM was detected at site F09.

3.6 SEDIMENT MACROFAUNA

Species counts with expanded taxonomy by operational taxonomic unit (OTU) and site is summarized in Table 6. A total of 53,149 counts of macrofauna (26,242 from site F04; 26,907 from site F10) included 340 OTUs spanning 14 phyla. The most commonly represented phyla based on the proportion of their respective taxa counts were the Annelida (60%), Mollusca (27%), Nematoda (9%), and Arthropoda (4%). Additional taxa were identified from the phyla: Bryozoa, Chordata, Echinodermata, Entoprocta, Kinorhyncha, Nemertea, Phoronida, Porifera, and Priapulida. The most common species observed was the nuculid bivalve *Nucula proxima* which represented 24% of the total OTU counts among samples.

3.7 SESTON

NA for Maritimes region in 2024.

3.8 ELEMENTAL CARBON AND NITROGEN

NA for Maritimes region in 2024.

3.9 CHLOROPHYLL

NA for Maritimes region in 2024.

3.10 ZOOPLANKTON

NA for Maritimes region in 2024.

3.11 OCEANOGRAPHY

NA for Maritimes region in 2024.

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Authorship contributions: JWFC wrote this report with methods contributions from CG (macrofauna lab protocols), SN (vessel, field protocols), and DW (sulfide protocols). JWFC performed all quality control and quality assurance on the data, analyzed all the data, created all the tables and figures, synthesized all the results, and revised and incorporated all editorial comments from co-author contributions. JWFC and SN co-led all work and field planning. JWFC, SN, LJ, and LJ performed the field work. SN and DW performed the sulfide analyses. All authors provided editorial comments and contributed to finalization of this report.

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APPENDIX I: DATA TABLES

TABLE 1. FIELD SURVEY DATES, SAMPLING, AND METADATA OF STANDARD AMP PARAMETERS.

Site	Dates	Benthic grabs	Macrofauna grabs	DPAB	TM	OM	SGS	TDS - ISE	TDS - UV	TDS - MB
F09	May 22-23	40	0	40	40	40	40	40	40	40
F04	Jul 15-19	47	30	47	47	47	47	47	47	47
F10	Aug 12-16	32	30	32	32	32	32	32	32	32
	TOTAL	119	60	119	119	119	119	119	119	119

TABLE 2. TOTAL SAMPLING EFFORT FOR AMP MARITIMES REGION IN 2024. All samples collected in 2024 were sent out for analysis. Only core AMP parameters returned for analysis are summarized in this report. Data to be generated from samples collected by AMP in support of CSRF projects and other science programs are available through those project leads (e.g. NA).

Parameter	Samples collected	Samples sent for analysis	Data returned from analyses
DPAB *(2cm depth)*	119	119	119
Grain size	119	119	60[a]
TM	119	119	119
OM	119	119	119
TDS - UV	119	119	119
TDS - MB	119	119	119
TDS – ISE	119	119	119
Macrofauna	60	60	60
AMR	55[b]	NA	NA
Total	***160***	***160***	***160***

[a]60 SGS samples collected as part of the CSRF project were analyzed by B. Law/V. Zions
[b]55 cryovial samples were collected for AMR and sent to external collaborators and excluded from totals.

TABLE 3. DPAB AND PERCENT MOISTURE CONTENT. DPAB units are in nanograms of analyte per gram of wet sample (ng/g). Please see main body text for definitions of method detection limits (MDL) and limit of quantification (LOQ) as provided by MB Labs.

			F09 – May (n=40)			F04 – Jul (n=47)			F10 – Aug (n=32)		
	MDL	LOQ	No. Pres.	min	max	No. Pres.	min	max	No. Pres.	min	max
Moisture Content (%)	na	na	40	20.7	69.1	47	10.0	57.3	32	18.9	66.1
Abamectin	0.44	1.39	0	0	0	0	0	0	0	0	0
Azamethiphos	0.05	0.16	0	0	0	0	0	0	0	0	0
Cypermethrin	2.70	8.58	0	0	0	0	0	0	0	0	0
Deltamethrin	1.01	3.20	0	0	0	0	0	0	0	0	0
Desmethyl EB	0.05	0.17	9	0.07	0.29	5	0.07	0.20	1	0.06	0.06
Emamectin	0.06	0.21	31	0.06	1.68	13	0.07	0.81	9	0.02	0.50
Erythromycin	0.14	0.44	0	0	0	0	0	0	0	0	0
Erythromycin-h2o	0.25	0.80	0	0	0	0	0	0	0	0	0
Florfenicol	0.12	0.37	0	0	0	0	0	0	0	0	0
Ivermectin	1.46	4.64	0	0	0	0	0	0	0	0	0
Lufenuron	0.07	0.22	9	0.10	0.16	8	0.08	0.48	10	0.07	1.16
Sulfadiazine	0.06	0.18	0	0	0	0	0	0	0	0	0
Suladimethoxine	0.06	0.19	0	0	0	0	0	0	0	0	0
Teflubenzuron	1.22	3.88	1	5.61	5.61	12	1.39	8.44	24	1.28	35.3
Trimethroprim	0.06	0.20	2	0.08	0.16	1	0.15	0.15	0	0	0
Amoxicillin	1.49	4.70	0	0	0	0	0	0	0	0	0
Oxytetracycline	0.08	0.26	39	0.09	140	19	0.09	5.37	31	0.18	99.7

No. present are the total stations where the DPAB was detected. The max represents the maximum value among stations at a site.

TABLE 4. TRACE METALS AND TOTAL ORGANIC CONTENT. Trace Metals units are reported in milligrams of analyte per kilogram of dry weight (mg/kg).

		F09 – May (n=40)			F04 – Jul (n=47)			F10 – Aug (n=32)		
	RL	mean	min	max	mean	min	max	mean	min	max
TOC (%)		4.5	1.1	8.6	2.2	0.7	5.3	3.6	0.6	6.3
Aluminum	1	16513	8840	20800	12771	9140	19300	14799	8510	20600
Antimony	0.1	0.3	0.1	0.5	<RL	<RL	<RL	0.1	0.1	0.1
Arsenic	1	9.7	6	17	8	6	11	9	4	13
Barium	1	54	17	66	35	20	59	40	15	59
Beryllium	0.1	1	0.2	1.2	0.7	0.4	1.1	0.8	0.3	1.1
Bismuth	1	<RL	<RL	<RL	<RL	<RL	<RL	<RL	<RL	<RL
Boron	1	39	14	53	26	16	43	30	11	48
Cadmium	0.01	0.17	0.04	0.56	0.09	0.04	0.20	0.2	0.05	0.35
Calcium	50	11234	3870	86100	26725	3180	78900	11781	1920	50500
Chromium	1	30	15	38	24	17	34	27	14	36
Cobalt	0.1	11.3	5.9	13.6	8.9	6.2	12.5	9.1	4.9	12.7
Copper	1	18	5	32	10	6	16	15	5	32
Iron	20	28200	17400	35700	24026	18300	31100	25969	15900	34700
Lead	0.1	19.6	9.1	23.9	13.7	9.1	21.9	15.9	6.5	24.3
Lithium	0.1	37.2	22.2	44.8	27.6	18.8	39.9	31.9	20.1	40.7
Magnesium	10	9483	4880	11800	7250	5040	10400	8169	5060	11100
Manganese	1	365	173	474	339	255	575	321	184	465
Mercury	0.01	0.03	0.01	0.04	0.02	0.01	0.09	0.03	0.01	0.04
Molybdenum	0.1	1.0	0.4	5.2	0.7	0.3	2.2	1.3	0.3	3.5
Nickel	1	27	14	35	20	13	30	23	12	31
Potassium	20	4957	1860	6190	3070	1960	5420	3473	1370	5360
Rubidium	0.1	26	11	32	17	10	29	19.3	8.3	28.7
Selenium	1	1	1	2	1	1	1	1	1	2
Silver	0.1	0.1	0.1	0.1	<RL	<RL	<RL	<RL	<RL	<RL
Sodium	50	13484	3170	18400	7649	3490	13200	11057	3980	18700
Strontium	1	67	28	544	103	20	249	62	14	207
Tellurium	0.1	<RL	<RL	<RL	<RL	<RL	<RL	<RL	<RL	<RL
Thallium	0.1	0.2	0.1	0.3	0.1	0.1	0.2	0.2	0.1	0.2
Tin	1	1	1	2	2	1	3	2	1	2
Uranium	0.1	1.3	0.8	3.5	1.0	0.6	2.0	1.3	0.7	2.6
Vanadium	1	43	23	52	38	28	51	39	23	53
Zinc	1	80	39	158	59	42	85	70	35	113

RL = lower reporting limit. Samples that were <RL were excluded from totals used for calculations.

TABLE 5. SEDIMENT TOTAL DISSOLVED SULFIDE (TDS) measured at 2 cm below sediment surface. Units are in µM.

	ISE method					UV method					MB method				
Site-Date	N	n	mean	min	max	N	n	mean	min	max	N	n	mean	min	max
F09-May	40	8	270	<LOQ	1090	40	38	226	<LOQ	584	40	1	1287	<LOQ	1287
F04-Jul	47	27	301	<LOQ	1460	47	45	134	<LOQ	683	47	1	814	<LOQ	814
F10-Aug	32	25	415	<LOQ	2180	32	32	161	54	856	32	0	<LOQ	<LOQ	<LOQ

N = Total samples collected. n = number of samples measured to be above the level of quantification (LOQ) and used for calculation summary statistics. ISE method LOQ = 100, UV method LOQ = 37 µM (430 nm), MB method LOQ = 200 µM.

TABLE 6. MACROFAUNA TAXONOMIC SUMMARY. Identified and enumerated from 30 stations sampled each at site F04 in July and F10 in August, 2024 with Total counts (Tot) also provided. Phylum (Phy) acronyms: ANN: Annelida, ART: Arthropoda, BRY: Bryozoa, CHO: Chordata, CNI: Cnidaria, ECH: Echinodermata, ENT: Entoprocta, KIN: Kinorhyncha, MOL: Mollusca, NMT: Nematoda, NMR: Nemertea, POR: Porifera, PHO: Phoronida, PRI: Priapulida. See text for how Operational Taxonomic Units (OTU) were determined based on Ranks (species: Spe; genus: gen; family: fam; order: ord; class: cla; phylum: phy).

OTU Identifier	Phy	Class	Order	Family	Genus	Rank	F04	F10	Tot
Alitta virens	ANN	Polychaeta	Phyllodocida	Nereididae	Alitta	Spe	12	200	212
Ampharete acutifrons	ANN	Polychaeta	Terebellida	Ampharetidae	Ampharete	Spe	3	2	5
Ampharete baltica	ANN	Polychaeta	Terebellida	Ampharetidae	Ampharete	Spe	79	3	82
Ampharete nr lindstroemi	ANN	Polychaeta	Terebellida	Ampharetidae	Ampharete	Spe	10	0	10
Ampharete oculata/sibirica (juv/dam)	ANN	Polychaeta	Terebellida	Ampharetidae	Ampharete	Spe	0	16	16
Ampharete sibirica	ANN	Polychaeta	Terebellida	Ampharetidae	Ampharete	Spe	0	2	2
Ampharete sp (juv/dam)	ANN	Polychaeta	Terebellida	Ampharetidae	Ampharete	Gen	44	3	47
Ampharetidae (juv/dam)	ANN	Polychaeta	Terebellida	Ampharetidae		Fam	4	0	4
Anobothrus gracilis	ANN	Polychaeta	Terebellida	Ampharetidae	Anobothrus	Spe	137	19	156
Aphelochaeta sp (juv/dam)	ANN	Polychaeta	Terebellida	Cirratulidae	Aphelochaeta	Gen	1	0	1
Aphelochaeta sp A	ANN	Polychaeta	Terebellida	Cirratulidae	Aphelochaeta	Gen	6	0	6
Apistobranchus typicus	ANN	Polychaeta	Spionida	Apistobranchidae	Apistobranchus	Spe	1	1	2
Aricidea (Acmira) catherinae	ANN	Polychaeta		Paraonidae	Aricidea	Spe	911	127	1038
Aricidea (Strelzovia) quadrilobata	ANN	Polychaeta		Paraonidae	Aricidea	Spe	10	7	17
Aricidea cf fragilis	ANN	Polychaeta		Paraonidae	Aricidea	Spe	2	0	2
Aricidea sp (juv/dam)	ANN	Polychaeta		Paraonidae	Aricidea	Gen	234	0	234
Aricidea sp A "orange"	ANN	Polychaeta		Paraonidae	Aricidea	Gen	3	0	3
Brada granosa	ANN	Polychaeta	Terebellida	Flabelligeridae	Brada	Spe	4	0	4
Bradabyssa villosa	ANN	Polychaeta	Terebellida	Flabelligeridae	Bradabyssa	Spe	12	2	14
Capitella capitata	ANN	Polychaeta		Capitellidae	Capitella	Spe	474	2599	3073
Chaetozone setosa	ANN	Polychaeta	Terebellida	Cirratulidae	Chaetozone	Spe	3	3	6
Chaetozone sp (juv/dam)	ANN	Polychaeta	Terebellida	Cirratulidae	Chaetozone	Gen	1	0	1
Chone duneri	ANN	Polychaeta	Sabellida	Sabellidae	Chone	Spe	18	0	18

Chone sp (juv/dam)	ANN	Polychaeta	Sabellida	Sabellidae	Chone	Gen	4	0	4
Chone/Euchone sp (juv/dam)	ANN	Polychaeta	Sabellida	Sabellidae	Chone/ Euchone	Gen	13	0	13
Cirratulidae (juv/dam)	ANN	Polychaeta	Terebellida	Cirratulidae		Fam	84	803	887
Cirratulus cirratus	ANN	Polychaeta	Terebellida	Cirratulidae	Cirratulus	Spe	2	0	2
Cistenides granulata	ANN	Polychaeta	Terebellida	Pectinariidae	Cistenides	Spe	0	5	5
Clitellio (Clitellio) arenarius	ANN	Clitellata	Tubificida	Naididae	Clitellio	Spe	0	12	12
Clymenella torquata	ANN	Polychaeta		Maldanidae	Clymenella	Spe	1	12	13
Cossura longocirrata	ANN	Polychaeta		Cossuridae	Cossura	Spe	2508	3373	5881
Dinophilidae	ANN	Polychaeta		Dinophilidae		Fam	1	0	1
Dipolydora caulleryi	ANN	Polychaeta	Spionida	Spionidae	Dipolydora	Spe	2	0	2
Dipolydora concharum	ANN	Polychaeta	Spionida	Spionidae	Dipolydora	Spe	13	3	16
Dipolydora sp (juv/dam)	ANN	Polychaeta	Spionida	Spionidae	Dipolydora	Gen	2	0	2
Drilonereis longa	ANN	Polychaeta	Eunicida	Oenonidae	Drilonereis	Spe	1	0	1
Epigamia alexandri	ANN	Polychaeta	Phyllodocida	Syllidae	Epigamia	Spe	0	1	1
Erinaceusyllis erinaceus	ANN	Polychaeta	Phyllodocida	Syllidae	Erinaceusyllis	Spe	3	0	3
Eteone longa	ANN	Polychaeta	Phyllodocida	Phyllodocidae	Eteone	Spe	47	121	168
Eteone sp (juv/dam)	ANN	Polychaeta	Phyllodocida	Phyllodocidae	Eteone	Gen	3	0	3
Euchone analis/elegans	ANN	Polychaeta	Sabellida	Sabellidae	Euchone	Spe	0	1	1
Euchone incolor	ANN	Polychaeta	Sabellida	Sabellidae	Euchone	Spe	679	195	874
Eulalia bilineata	ANN	Polychaeta	Phyllodocida	Phyllodocidae	Eulalia	Spe	3	0	3
Exogone dispar	ANN	Polychaeta	Phyllodocida	Syllidae	Exogone	Spe	1	0	1
Exogone verugera	ANN	Polychaeta	Phyllodocida	Syllidae	Exogone	Spe	8	3	11
Fabricia stellaris	ANN	Polychaeta	Sabellida	Fabriciidae	Fabricia	Spe	0	417	417
Flabelligera affinis	ANN	Polychaeta	Terebellida	Flabelligeridae	Flabelligera	Spe	6	10	16
Galathowenia oculata	ANN	Polychaeta		Oweniidae	Galathowenia	Spe	5	0	5
Gattyana cirrhosa	ANN	Polychaeta	Phyllodocida	Polynoidae	Gattyana	Spe	1	0	1
Harmothoe imbricata	ANN	Polychaeta	Phyllodocida	Polynoidae	Harmothoe	Spe	15	1	16
Harmothoe sp (juv/dam)	ANN	Polychaeta	Phyllodocida	Polynoidae	Harmothoe	Gen	1	0	1
Hartmania moorei	ANN	Polychaeta	Phyllodocida	Polynoidae	Hartmania	Spe	6	1	7
Hypereteone lactea	ANN	Polychaeta	Phyllodocida	Phyllodocidae	Hypereteone	Spe	1	0	1
Kirkegaardia baptisteae	ANN	Polychaeta	Terebellida	Cirratulidae	Kirkegaardia	Spe	209	31	240

Kirkegaardia hampsoni	ANN	Polychaeta	Terebellida	Cirratulidae	Kirkegaardia	Spe	149	1	150
Kirkegaardia sp (juv/dam)	ANN	Polychaeta	Terebellida	Cirratulidae	Kirkegaardia	Gen	8	0	8
Lanassa venusta	ANN	Polychaeta	Terebellida	Terebellidae	Lanassa	Spe	0	3	3
Laonome kroyeri	ANN	Polychaeta	Sabellida	Sabellidae	Laonome	Spe	0	1	1
Leitoscoloplos acutus	ANN	Polychaeta		Orbiniidae	Leitoscoloplos	Spe	1	2	3
Lepidonotus squamatus	ANN	Polychaeta	Phyllodocida	Polynoidae	Lepidonotus	Spe	1	1	2
Levinsenia gracilis	ANN	Polychaeta		Paraonidae	Levinsenia	Spe	498	110	608
Maldanidae (juv/dam)	ANN	Polychaeta		Maldanidae		Fam	0	2	2
Mediomastus californiensis/fragilis	ANN	Polychaeta		Capitellidae	Mediomastus	Spe	56	19	75
Mediomastus sp (juv/dam)	ANN	Polychaeta		Capitellidae	Mediomastus	Gen	14	2	16
Melinna elisabethae	ANN	Polychaeta	Terebellida	Melinnidae	Melinna	Spe	3	2	5
Melinna sp (juv/dam)	ANN	Polychaeta	Terebellida	Melinnidae	Melinna	Gen	0	3	3
Micronephthys cf minuta	ANN	Polychaeta	Phyllodocida	Nephtyidae	Micronephthys	Spe	0	1	1
Micronephthys neotena	ANN	Polychaeta	Phyllodocida	Nephtyidae	Micronephthys	Spe	8	38	46
Micronephthys sp (juv/dam)	ANN	Polychaeta	Phyllodocida	Nephtyidae	Micronephthys	Gen	1	0	1
Microphthalmus aberrans	ANN	Polychaeta	Phyllodocida	Microphthalmidae	Microphthalmus	Spe	8	78	86
Myrianida prolifera	ANN	Polychaeta	Phyllodocida	Syllidae	Myrianida	Spe	0	1	1
Naididae (juv/dam)	ANN	Clitellata	Tubificida	Naididae		Fam	301	484	785
Neoamphitrite figulus	ANN	Polychaeta	Terebellida	Terebellidae	Neoamphitrite	Spe	1	0	1
Nephasoma spp	ANN		Sipuncula	Golfingiidae	Nephasoma	Gen	2	0	2
Nephtys caeca	ANN	Polychaeta	Phyllodocida	Nephtyidae	Nephtys	Spe	0	2	2
Nephtys incisa	ANN	Polychaeta	Phyllodocida	Nephtyidae	Nephtys	Spe	43	25	68
Nephtys pente	ANN	Polychaeta	Phyllodocida	Nephtyidae	Nephtys	Spe	0	16	16
Nephtys sp (juv/dam)	ANN	Polychaeta	Phyllodocida	Nephtyidae	Nephtys	Gen	3	2	5
Nereididae (juv/dam)	ANN	Polychaeta	Phyllodocida	Nereididae		Fam	2	0	2
Nereis pelagica	ANN	Polychaeta	Phyllodocida	Nereididae	Nereis	Spe	2	0	2
Nereis sp (juv/dam)	ANN	Polychaeta	Phyllodocida	Nereididae	Nereis	Gen	1	0	1
Ninoe nigripes	ANN	Polychaeta	Eunicida	Lumbrineridae	Ninoe	Spe	483	97	580
Ophelina acuminata	ANN	Polychaeta		Opheliidae	Ophelina	Spe	437	395	832
Orbiniidae (juv/dam)	ANN	Polychaeta		Orbiniidae		Fam	1	0	1

Owenia fusiformis	ANN	Polychaeta		Oweniidae	Owenia	Spe	2	0	2
Paranais litoralis	ANN	Clitellata	Tubificida	Naididae	Paranais	Spe	1	515	516
Paranaitis speciosa	ANN	Polychaeta	Phyllodocida	Phyllodocidae	Paranaitis	Spe	1	0	1
Parexogone hebes	ANN	Polychaeta	Phyllodocida	Syllidae	Parexogone	Spe	4	20	24
Parexogone longicirris	ANN	Polychaeta	Phyllodocida	Syllidae	Parexogone	Spe	1	0	1
Parougia caeca	ANN	Polychaeta	Eunicida	Dorvilleidae	Parougia	Spe	0	2	2
Parougia nr eliasoni	ANN	Polychaeta	Eunicida	Dorvilleidae	Parougia	Spe	24	9	33
Parougia sp (juv/dam)	ANN	Polychaeta	Eunicida	Dorvilleidae	Parougia	Gen	1	1	2
Phascolion (Phascolion) strombus	ANN		Sipuncula	Golfingiidae	Phascolion	Spe	23	6	29
Pherusa affinis	ANN	Polychaeta	Terebellida	Flabelligeridae	Pherusa	Spe	0	3	3
Pherusa plumosa	ANN	Polychaeta	Terebellida	Flabelligeridae	Pherusa	Spe	0	10	10
Pholoe longa	ANN	Polychaeta	Phyllodocida	Sigalionidae	Pholoe	Spe	14	0	14
Pholoe minuta	ANN	Polychaeta	Phyllodocida	Sigalionidae	Pholoe	Spe	34	95	129
Pholoe sp (juv/dam)	ANN	Polychaeta	Phyllodocida	Sigalionidae	Pholoe	Gen	9	0	9
Phyllodoce maculata	ANN	Polychaeta	Phyllodocida	Phyllodocidae	Phyllodoce	Spe	4	2	6
Phyllodoce mucosa	ANN	Polychaeta	Phyllodocida	Phyllodocidae	Phyllodoce	Spe	12	19	31
Phyllodoce sp (juv/dam)	ANN	Polychaeta	Phyllodocida	Phyllodocidae	Phyllodoce	Gen	0	1	1
Polycirrus cf eximius	ANN	Polychaeta	Terebellida	Terebellidae	Polycirrus	Spe	10	0	10
Polycirrus eximius	ANN	Polychaeta	Terebellida	Terebellidae	Polycirrus	Spe	0	5	5
Polycirrus sp (juv/dam)	ANN	Polychaeta	Terebellida	Terebellidae	Polycirrus	Gen	26	13	39
Polycirrus sp A	ANN	Polychaeta	Terebellida	Terebellidae	Polycirrus	Gen	0	3	3
Polydora cornuta	ANN	Polychaeta	Spionida	Spionidae	Polydora	Spe	0	135	135
Polydora sp (juv/dam)	ANN	Polychaeta	Spionida	Spionidae	Polydora	Gen	1	0	1
Polydora websteri	ANN	Polychaeta	Spionida	Spionidae	Polydora	Spe	2	0	2
Potamilla neglecta	ANN	Polychaeta	Sabellida	Sabellidae	Potamilla	Spe	7	0	7
Praxillella praetermissa	ANN	Polychaeta		Maldanidae	Praxillella	Spe	4	0	4
Prionospio steenstrupi	ANN	Polychaeta	Spionida	Spionidae	Prionospio	Spe	169	319	488
Proceraea cornuta	ANN	Polychaeta	Phyllodocida	Syllidae	Proceraea	Spe	1	1	2
Psamathe fusca	ANN	Polychaeta	Phyllodocida	Hesionidae	Psamathe	Spe	5	0	5
Pseudopotamilla reniformis	ANN	Polychaeta	Sabellida	Sabellidae	Pseudopotamilla	Spe	1	0	1
Pygospio elegans	ANN	Polychaeta	Spionida	Spionidae	Pygospio	Spe	1	92	93

Rhodine gracilior	ANN	Polychaeta		Maldanidae	Rhodine	Spe	46	1	47
Rhodine sp (juv/dam)	ANN	Polychaeta		Maldanidae	Rhodine	Gen	76	3	79
Sabellaria vulgaris	ANN	Polychaeta		Sabellariidae	Sabellaria	Spe	1	0	1
Sabellidae (juv/dam)	ANN	Polychaeta	Sabellida	Sabellidae		Fam	1	1	2
Saphobranchia hirsuta	ANN	Polychaeta	Terebellida	Flabelligeridae	Saphobranchia	Spe	1	0	1
Scalibregma inflatum	ANN	Polychaeta		Scalibregmatidae	Scalibregma	Spe	1	3	4
Scolelepis sp (juv/dam)	ANN	Polychaeta	Spionida	Spionidae	Scolelepis	Gen	0	1	1
Scoletoma fragilis	ANN	Polychaeta	Eunicida	Lumbrineridae	Scoletoma	Spe	23	0	23
Scoletoma hebes	ANN	Polychaeta	Eunicida	Lumbrineridae	Scoletoma	Spe	95	41	136
Scoletoma sp (juv/dam)	ANN	Polychaeta	Eunicida	Lumbrineridae	Scoletoma	Gen	41	5	46
Sipuncula (juv/dam)	ANN		Sipuncula			Ord	1	0	1
Sphaerodoridium minutum	ANN	Polychaeta	Phyllodocida	Sphaerodoridae	Sphaerodoridium	Spe	1	0	1
Spio filicornis	ANN	Polychaeta	Spionida	Spionidae	Spio	Spe	6	2	8
Spio sp (juv/dam)	ANN	Polychaeta	Spionida	Spionidae	Spio	Gen	3	0	3
Spio sp A "18,5"	ANN	Polychaeta	Spionida	Spionidae	Spio	Gen	22	12	34
Spionidae (juv/dam)	ANN	Polychaeta	Spionida	Spionidae		Fam	0	4	4
Spiophanes bombyx	ANN	Polychaeta	Spionida	Spionidae	Spiophanes	Spe	1	1	2
Spirorbinae (juv/dam)	ANN	Polychaeta	Sabellida	Serpulidae		Subfam	2	0	2
Spirorbis (Spirorbis) spirorbis	ANN	Polychaeta	Sabellida	Serpulidae	Spirorbis	Spe	0	1	1
Sternaspis fossor	ANN	Polychaeta	Terebellida	Sternaspidae	Sternaspis	Spe	6	1	7
Streblospio benedicti	ANN	Polychaeta	Spionida	Spionidae	Streblospio	Spe	0	2174	2174
Syllides japonicus	ANN	Polychaeta	Phyllodocida	Syllidae	Syllides	Spe	3	0	3
Syllides sp (juv/dam)	ANN	Polychaeta	Phyllodocida	Syllidae	Syllides	Gen	1	0	1
Syllis cornuta	ANN	Polychaeta	Phyllodocida	Syllidae	Syllis	Spe	1	0	1
Terebellidae (juv/dam)	ANN	Polychaeta	Terebellida	Terebellidae		Fam	1	0	1
Terebellides sp (juv/dam)	ANN	Polychaeta	Terebellida	Trichobranchidae	Terebellides	Gen	2	0	2
Terebellides stroemii	ANN	Polychaeta	Terebellida	Trichobranchidae	Terebellides	Spe	881	38	919
Tharyx acutus	ANN	Polychaeta	Terebellida	Cirratulidae	Tharyx	Spe	385	253	638
Tharyx sp (juv/dam)	ANN	Polychaeta	Terebellida	Cirratulidae	Tharyx	Gen	319	290	609
Tharyx sp A	ANN	Polychaeta	Terebellida	Cirratulidae	Tharyx	Gen	164	1490	1654
Tubificoides benedii	ANN	Clitellata	Tubificida	Naididae	Tubificoides	Spe	0	1689	1689

Tubificoides cf pseudogaster	ANN	Clitellata	Tubificida	Naididae	Tubificoides	Spe	760	1775	2535
Tubificoides intermedius	ANN	Clitellata	Tubificida	Naididae	Tubificoides	Spe	867	1751	2618
Acari	ART	Arachnida				Sub Cla	1	1	2
Achelia spinosa	ART	Pycnogonida	Pantopoda	Ammotheidae	Achelia	Spe	10	0	10
Ampelisca abdita	ART	Malacostraca	Amphipoda	Ampeliscidae	Ampelisca	Spe	0	1384	1384
Ampelisca sp (juv/dam)	ART	Malacostraca	Amphipoda	Ampeliscidae	Ampelisca	Gen	1	0	1
Ampelisca vadorum	ART	Malacostraca	Amphipoda	Ampeliscidae	Ampelisca	Spe	2	0	2
Anonyx cf lilljeborgi	ART	Malacostraca	Amphipoda	Uristidae	Anonyx	Spe	2	0	2
Argissa hamatipes	ART	Malacostraca	Amphipoda	Argissidae	Argissa	Spe	3	0	3
Balanus crenatus	ART	Thecostraca	Balanomorpha	Balanidae	Balanus	Spe	1	0	1
Balanus/Semibalanus sp (juv/dam)	ART	Thecostraca	Balanomorpha	Balanidae	Balanus/ Semibalanus	Gen	4	0	4
Brachyura	ART	Malacostraca	Decapoda			InfOrd	1	0	1
Casco bigelowi	ART	Malacostraca	Amphipoda	Cheirocratidae	Casco	Spe	13	2	15
Chironomidae	ART	Hexapoda	Diptera	Chironomidae		Fam	0	13	13
Chondrochelia savignyi	ART	Malacostraca	Tanaidacea	Leptocheliidae	Chondrochelia	Spe	2	0	2
Corophiinae (juv/dam)	ART	Malacostraca	Amphipoda	Corophiidae		Subfam	13	2	15
Crassicorophium bonellii	ART	Malacostraca	Amphipoda	Corophiidae	Crassicorophium	Spe	8	6	14
Cyclopoida	ART	Copepoda	Cyclopoida			Ord	0	1	1
Deflexilodes tuberculatus	ART	Malacostraca	Amphipoda	Oedicerotidae	Deflexilodes	Spe	4	0	4
Diastylis quadrispinosa	ART	Malacostraca	Cumacea	Diastylidae	Diastylis	Spe	16	1	17
Diastylis sculpta	ART	Malacostraca	Cumacea	Diastylidae	Diastylis	Spe	3	11	14
Diastylis sp (juv/dam)	ART	Malacostraca	Cumacea	Diastylidae	Diastylis	Gen	4	5	9
Dulichia falcata	ART	Malacostraca	Amphipoda	Dulichiidae	Dulichia	Spe	1	1	2
Dulichiidae (juv/dam)	ART	Malacostraca	Amphipoda	Dulichiidae		Fam	6	6	12
Dyopedos monacanthus	ART	Malacostraca	Amphipoda	Dulichiidae	Dyopedos	Spe	6	4	10
Edotia triloba	ART	Malacostraca	Isopoda	Idoteidae	Edotia	Spe	9	2	11
Eudorella pusilla	ART	Malacostraca	Cumacea	Leuconidae	Eudorella	Spe	1	0	1
Gammaroidea (juv/dam)	ART	Malacostraca	Amphipoda			Supfam	2	0	2

Gammarus lawrencianus	ART	Malacostraca	Amphipoda	Gammaridae	Gammarus	Spe	0	51	51
Gammarus sp (juv/dam)	ART	Malacostraca	Amphipoda	Gammaridae	Gammarus	Gen	0	9	9
Gracilipleustes inermis	ART	Malacostraca	Amphipoda	Pleustidae	Gracilipleustes	Spe	1	0	1
Gracilipleustes sp (juv/dam)	ART	Malacostraca	Amphipoda	Pleustidae	Gracilipleustes	Gen	1	1	2
Halacaridae	ART	Arachnida	Trombidiformes	Halacaridae		Fam	2	5	7
Harpacticoida	ART	Copepoda	Harpacticoida			Ord	23	126	149
Harpinia propinqva	ART	Malacostraca	Amphipoda	Phoxocephalidae	Harpinia	Spe	20	0	20
Harpinia sp (juv/dam)	ART	Malacostraca	Amphipoda	Phoxocephalidae	Harpinia	Gen	2	0	2
Idotea phosphorea	ART	Malacostraca	Isopoda	Idoteidae	Idotea	Spe	2	0	2
Leptocheirus pinguis	ART	Malacostraca	Amphipoda	Corophiidae	Leptocheirus	Spe	11	0	11
Maera danae	ART	Malacostraca	Amphipoda	Maeridae	Maera	Spe	5	0	5
Monocorophium insidiosum	ART	Malacostraca	Amphipoda	Corophiidae	Monocorophium	Spe	0	57	57
Munna fabricii	ART	Malacostraca	Isopoda	Munnidae	Munna	Spe	7	0	7
Nymphon brevirostre	ART	Pycnogonida	Pantopoda	Nymphonidae	Nymphon	Spe	0	1	1
Orchomenella minuta	ART	Malacostraca	Amphipoda	Tryphosidae	Orchomenella	Spe	5	3	8
Ostracoda	ART	Ostracoda				Cla	57	8	65
Parapleustes spp	ART	Malacostraca	Amphipoda	Pleustidae	Parapleustes	Gen	2	0	2
Photis pollex	ART	Malacostraca	Amphipoda	Photidae	Photis	Spe	2	2	4
Photis sp (female)	ART	Malacostraca	Amphipoda	Photidae	Photis	Gen	14	9	23
Phoxocephalus holbolli	ART	Malacostraca	Amphipoda	Phoxocephalidae	Phoxocephalus	Spe	0	11	11
Pleurogonium inerme	ART	Malacostraca	Isopoda	Paramunnidae	Pleurogonium	Spe	19	12	31
Pleurogonium rubicundum	ART	Malacostraca	Isopoda	Paramunnidae	Pleurogonium	Spe	1	0	1
Pleustidae (juv/dam)	ART	Malacostraca	Amphipoda	Pleustidae		Fam	1	0	1
Proboloides holmesi	ART	Malacostraca	Amphipoda	Stenothoidae	Proboloides	Spe	0	1	1
Pseudonototanais filum	ART	Malacostraca	Tanaidacea	Leptocheliidae	Pseudonototanais	Spe	0	1	1
Semibalanus balanoides	ART	Thecostraca	Balanomorpha	Balanidae	Semibalanus	Spe	94	7	101
Stenothoidae (juv/dam)	ART	Malacostraca	Amphipoda	Stenothoidae		Fam	2	0	2
Stenula cf peltata	ART	Malacostraca	Amphipoda	Stenothoidae	Stenula	Spe	1	0	1
Unciola irrorata	ART	Malacostraca	Amphipoda	Unciolidae	Unciola	Spe	14	17	31
Unciola sp (juv/dam)	ART	Malacostraca	Amphipoda	Unciolidae	Unciola	Gen	3	2	5

Amathia spp	BRY	Gymnolaemata	Ctenostomatida	Vesiculariidae	Amathia	Gen	9	6	15
Amphiblestrum auritum	BRY	Gymnolaemata	Cheilostomatida	Calloporidae	Amphiblestrum	Spe	3	3	6
Amphiblestrum flemingii	BRY	Gymnolaemata	Cheilostomatida	Calloporidae	Amphiblestrum	Spe	2	0	2
Amphiblestrum osburni	BRY	Gymnolaemata	Cheilostomatida	Calloporidae	Amphiblestrum	Spe	4	1	5
Amphiblestrum sp (juv/dam)	BRY	Gymnolaemata	Cheilostomatida	Calloporidae	Amphiblestrum	Gen	18	4	22
Aquiloniella scabra	BRY	Gymnolaemata	Cheilostomatida	Candidae	Aquiloniella	Spe	0	1	1
Arachnidium fibrosum	BRY	Gymnolaemata	Ctenostomatida	Arachnidiidae	Arachnidium	Spe	8	5	13
Bicellariella ciliata	BRY	Gymnolaemata	Cheilostomatida	Bugulidae	Bicellariella	Spe	0	2	2
Bugulina fulva	BRY	Gymnolaemata	Cheilostomatida	Bugulidae	Bugulina	Spe	2	3	5
Bugulina stolonifera	BRY	Gymnolaemata	Cheilostomatida	Bugulidae	Bugulina	Spe	10	0	10
Caberea ellisii	BRY	Gymnolaemata	Cheilostomatida	Candidae	Caberea	Spe	1	2	3
Callopora sedovi	BRY	Gymnolaemata	Cheilostomatida	Calloporidae	Callopora	Spe	2	2	4
Callopora sp (juv/dam)	BRY	Gymnolaemata	Cheilostomatida	Calloporidae	Callopora	Gen	2	0	2
Celleporella hyalina	BRY	Gymnolaemata	Cheilostomatida	Hippothoidae	Celleporella	Spe	4	8	12
Cribrilina punctata	BRY	Gymnolaemata	Cheilostomatida	Cribrilinidae	Cribrilina	Spe	40	17	57
Crisia denticulata	BRY	Stenolaemata	Cyclostomatida	Crisiidae	Crisia	Spe	5	0	5
Crisia sp (juv/dam)	BRY	Stenolaemata	Cyclostomatida	Crisiidae	Crisia	Gen	0	1	1
Cylindroporella tubulosa	BRY	Gymnolaemata	Cheilostomatida	Lacernidae	Cylindroporella	Spe	0	2	2
Dendrobeania murrayana	BRY	Gymnolaemata	Cheilostomatida	Bugulidae	Dendrobeania	Spe	11	2	13
Einhornia arctica	BRY	Gymnolaemata	Cheilostomatida	Electridae	Einhornia	Spe	92	26	118
Escharella immersa	BRY	Gymnolaemata	Cheilostomatida	Escharellidae	Escharella	Spe	4	0	4
Escharella sp (juv/dam)	BRY	Gymnolaemata	Cheilostomatida	Escharellidae	Escharella	Gen	0	1	1
Eucratea loricata	BRY	Gymnolaemata	Cheilostomatida	Eucrateidae	Eucratea	Spe	13	9	22
Fenestrulina delicia	BRY	Gymnolaemata	Cheilostomatida	Fenestrulinidae	Fenestrulina	Spe	2	1	3
Haplota clavata	BRY	Gymnolaemata	Cheilostomatida	Hippothoidae	Haplota	Spe	2	1	3
Hippoporella hippopus	BRY	Gymnolaemata	Cheilostomatida	Hippoporidridae	Hippoporella	Spe	3	0	3
Juxtacribrilina annulata	BRY	Gymnolaemata	Cheilostomatida	Cribrilinidae	Juxtacribrilina	Spe	2	1	3
Microporella sp (juv/dam)	BRY	Gymnolaemata	Cheilostomatida	Microporellidae	Microporella	Gen	2	0	2
Microporella stellata	BRY	Gymnolaemata	Cheilostomatida	Microporellidae	Microporella	Spe	0	2	2
Nolella spp	BRY	Gymnolaemata	Ctenostomatida	Nolellidae	Nolella	Gen	5	0	5

Porella acutirostris	BRY	Gymnolaemata	Cheilostomatida	Bryocryptellidae	Porella	Spe	1	1	2
Porella cf acutirostris	BRY	Gymnolaemata	Cheilostomatida	Bryocryptellidae	Porella	Spe	1	0	1
Porella sp?	BRY	Gymnolaemata	Cheilostomatida	Bryocryptellidae	Porella	Gen	1	0	1
Stomacrustula sp (juv/dam)	BRY	Gymnolaemata	Cheilostomatida	Fatkullinidae	Stomacrustula	Gen	1	0	1
Tegella unicornis	BRY	Gymnolaemata	Cheilostomatida	Calloporidae	Tegella	Spe	2	1	3
Triticella cf pedicellata	BRY	Gymnolaemata	Ctenostomatida	Triticellidae	Triticella	Spe	9	0	9
Tubulipora spp	BRY	Stenolaemata	Cyclostomatida	Tubuliporidae	Tubulipora	Gen	0	1	1
Dendrodoa carnea	CHO	Ascidiacea	Stolidobranchia	Styelidae	Dendrodoa	Spe	5	1	6
Styela coriacea	CHO	Ascidiacea	Stolidobranchia	Styelidae	Styela	Spe	2	0	2
Acaulis primarius	CNI	Hydrozoa	Anthoathecata	Acaulidae	Acaulis	Spe	1	0	1
Actiniaria (juv/dam)	CNI	Hexacorallia	Scleractinia	Actinacididae	Actinaraea	Gen	2	0	2
Bougainvilliidae (juv/dam)	CNI	Hydrozoa	Anthoathecata	Bougainvilliidae		Fam	1	0	1
Calycella syringa	CNI	Hydrozoa	Leptothecata	Campanulinidae	Calycella	Spe	2	7	9
Campanularia volubilis	CNI	Hydrozoa	Leptothecata	Campanulariidae	Campanularia	Spe	2	0	2
Campanulariidae (juv/dam)	CNI	Hydrozoa	Leptothecata	Campanulariidae		Fam	7	0	7
Clytia gracilis	CNI	Hydrozoa	Leptothecata	Campanulariidae	Clytia	Spe	1	0	1
Clytia hemisphaerica	CNI	Hydrozoa	Leptothecata	Campanulariidae	Clytia	Spe	3	0	3
Clytia sp (juv/dam)	CNI	Hydrozoa	Leptothecata	Campanulariidae	Clytia	Gen	1	0	1
Diphasia rosacea	CNI	Hydrozoa	Leptothecata	Sertulariidae	Diphasia	Spe	0	4	4
Diphasia sp (juv/dam)	CNI	Hydrozoa	Leptothecata	Sertulariidae	Diphasia	Gen	1	1	2
Dynamena pumila	CNI	Hydrozoa	Leptothecata	Sertulariidae	Dynamena	Spe	2	4	6
Edwardsia elegans	CNI	Hexacorallia	Actiniaria	Edwardsiidae	Edwardsia	Spe	3	0	3
Edwardsia sp (juv/dam)	CNI	Hexacorallia	Actiniaria	Edwardsiidae	Edwardsia	Gen	1	1	2
Eudendrium album?	CNI	Hydrozoa	Anthoathecata	Eudendriidae	Eudendrium	Spe	1	0	1
Gonothyraea loveni/Hartlaubella gelatinosa (juv/dam)	CNI	Hydrozoa	Leptothecata	Campanulariidae	Gonothyraea/ Hartlaubella	Spe	2	0	2
Halecium sp (juv/dam)	CNI	Hydrozoa	Leptothecata	Haleciidae	Halecium	Gen	1	1	2
Hydrallmania falcata	CNI	Hydrozoa	Leptothecata	Sertulariidae	Hydrallmania	Spe	5	9	14
Lafoea dumosa	CNI	Hydrozoa	Leptothecata	Lafoeidae	Lafoea	Spe	1	2	3
Obelia dichotoma	CNI	Hydrozoa	Leptothecata	Campanulariidae	Obelia	Spe	1	0	1
Obelia dichotoma/longissima	CNI	Hydrozoa	Leptothecata	Campanulariidae	Obelia	Spe	1	0	1

Obelia geniculata	CNI	Hydrozoa	Leptothecata	Campanulariidae	Obelia	Spe	0	4	4
Obelia longissima	CNI	Hydrozoa	Leptothecata	Campanulariidae	Obelia	Spe	0	1	1
Obelia sp (juv/dam)	CNI	Hydrozoa	Leptothecata	Campanulariidae	Obelia	Gen	1	0	1
Pachycerianthus borealis	CNI	Hexacorallia	Ceriantharia	Cerianthidae	Pachycerianthus	Spe	1	1	2
Rhizocaulus verticillatus	CNI	Hydrozoa	Leptothecata	Campanulariidae	Rhizocaulus	Spe	1	0	1
Sertularia argentea/cupressina	CNI	Hydrozoa	Leptothecata	Sertulariidae	Sertularia	Spe	0	2	2
Sertularia cupressina	CNI	Hydrozoa	Leptothecata	Sertulariidae	Sertularia	Spe	0	2	2
Sertularia sp (juv/dam)	CNI	Hydrozoa	Leptothecata	Sertulariidae	Sertularia	Gen	18	14	32
Symplectoscyphus tricuspidatus	CNI	Hydrozoa	Leptothecata	Symplectoscyphidae	Symplectoscyphus	Spe	4	5	9
Tubularia indivisa / Ectopleura crocea	CNI	Hydrozoa	Anthoathecata	Tubulariidae	Tubularia/ Ectopleura	Spe	1	0	1
Amphipholis squamata	ECH	Ophiuroidea	Amphilepidida	Amphiuridae	Amphipholis	Spe	9	1	10
Barentsia spp	ENT			Barentsiidae	Barentsia	Gen	2	1	3
Pycnophyes spp	KIN	Allomalorhagida	Allomalorhagida incertae sedis	Pycnophyidae	Pycnophyes	Gen	10	15	25
Agriopoma morrhuanum	MOL	Bivalvia	Venerida	Veneridae	Agriopoma	Spe	25	0	25
Ameritella agilis	MOL	Bivalvia	Cardiida	Tellinidae	Ameritella	Spe	4	0	4
Antalis entalis	MOL	Scaphopoda	Dentaliida	Dentaliidae	Antalis	Spe	1	0	1
Arctica islandica	MOL	Bivalvia	Venerida	Arcticidae	Arctica	Spe	60	7	67
Arvella faba	MOL	Bivalvia	Mytilida	Mytilidae	Arvella	Spe	1	0	1
Astarte sp (juv/dam)	MOL	Bivalvia	Carditida	Astartidae	Astarte	Gen	110	5	115
Astarte undata	MOL	Bivalvia	Carditida	Astartidae	Astarte	Spe	30	4	34
Astyris lunata	MOL	Gastropoda	Neogastropoda	Columbellidae	Astyris	Spe	16	0	16
Bivalvia (juv/dam)	MOL	Bivalvia				Cla	14	25	39
Crenella decussata	MOL	Bivalvia	Mytilida	Mytilidae	Crenella	Spe	10	2	12
Crucibulum striatum	MOL	Gastropoda	Littorinimorpha	Calyptraeidae	Crucibulum	Spe	1	0	1
Cyclocardia borealis	MOL	Bivalvia	Carditida	Carditidae	Cyclocardia	Spe	94	8	102
Ecrobia truncata	MOL	Gastropoda	Littorinimorpha	Hydrobiidae	Ecrobia	Spe	0	149	149
Ennucula delphinodonta	MOL	Bivalvia	Nuculida	Nuculidae	Ennucula	Spe	102	5	107
Ennucula tenuis	MOL	Bivalvia	Nuculida	Nuculidae	Ennucula	Spe	1	0	1
Ennucula/Nucula sp (juv/dam)	MOL	Bivalvia	Nuculida	Nuculidae		Fam	0	51	51
Ensis leei/terranovensis	MOL	Bivalvia	Adapedonta	Pharidae	Ensis	Spe	1	24	25

Ensis terranovensis	MOL	Bivalvia	Adapedonta	Pharidae	Ensis	Spe	0	10	10
Eulimella polita?	MOL	Gastropoda		Pyramidellidae	Eulimella	Spe	1	0	1
Frigidoalvania carinata	MOL	Gastropoda	Littorinimorpha	Rissoidae	Frigidoalvania	Spe	88	1	89
Gastropoda (juv/dam)	MOL	Gastropoda				Cla	2	1	3
Hiatella arctica	MOL	Bivalvia	Adapedonta	Hiatellidae	Hiatella	Spe	1	6	7
Ilyanassa trivittata	MOL	Gastropoda	Neogastropoda	Nassariidae	Ilyanassa	Spe	2	0	2
Lacuna pallidula	MOL	Gastropoda	Littorinimorpha	Littorinidae	Lacuna	Spe	0	1	1
Lyonsia arenosa	MOL	Bivalvia		Lyonsiidae	Lyonsia	Spe	23	0	23
Margarites helicinus	MOL	Gastropoda	Trochida	Margaritidae	Margarites	Spe	1	0	1
Modiolus modiolus	MOL	Bivalvia	Mytilida	Modiolidae	Modiolus	Spe	1	0	1
Moelleria costulata	MOL	Gastropoda	Trochida	Colloniidae	Moelleria	Spe	1	0	1
Mya arenaria	MOL	Bivalvia	Myida	Myidae	Mya	Spe	12	10	22
Mytilus edulis/trossulus	MOL	Bivalvia	Mytilida	Mytilidae	Mytilus	Spe	17	16	33
Nucula proxima	MOL	Bivalvia	Nuculida	Nuculidae	Nucula	Spe	10738	2200	12938
Onoba mighelsii	MOL	Gastropoda	Littorinimorpha	Rissoidae	Onoba	Spe	2	1	3
Parvicardium pinnulatum	MOL	Bivalvia	Cardiida	Cardiidae	Parvicardium	Spe	6	0	6
Periploma fragile	MOL	Bivalvia		Periplomatidae	Periploma	Spe	75	1	76
Periplomatidae (juv/dam)	MOL	Bivalvia		Periplomatidae		Fam	1	0	1
Retusa obtusa	MOL	Gastropoda	Cephalaspidea	Retusidae	Retusa	Spe	1	0	1
Scaphopoda (juv/dam)	MOL	Scaphopoda				Cla	5	0	5
Solemya velum/Petrasma borealis (juv/dam)	MOL	Bivalvia	Solemyida	Solemyidae	Solemya	Spe	1	0	1
Stenosemus albus	MOL	Polyplacophora	Chitonida	Ischnochitonidae	Stenosemus	Spe	1	0	1
Thracia septentrionalis	MOL	Bivalvia		Thraciidae	Thracia	Spe	9	1	10
Thracia sp (juv/dam)	MOL	Bivalvia		Thraciidae	Thracia	Gen	1	0	1
Thyasira gouldii	MOL	Bivalvia	Lucinida	Thyasiridae	Thyasira	Spe	31	1	32
Thyasiridae (juv/dam)	MOL	Bivalvia	Lucinida	Thyasiridae		Fam	0	1	1
Yoldia limatula	MOL	Bivalvia	Nuculanida	Yoldiidae	Yoldia	Spe	0	3	3
Yoldia sapotilla	MOL	Bivalvia	Nuculanida	Yoldiidae	Yoldia	Spe	32	0	32
Yoldia sp (juv/dam)	MOL	Bivalvia	Nuculanida	Yoldiidae	Yoldia	Gen	22	12	34
Nematoda	NMT					Phy	2182	2352	4534
Amphiporus angulatus	NMR	Hoplonemertea	Monostilifera	Amphiporidae	Amphiporus	Spe	1	1	2

Amphiporus caecus	NMR	Hoplonemertea	Monostilifera	Amphiporidae	Amphiporus	Spe	0	2	2
Amphiporus spp	NMR	Hoplonemertea	Monostilifera	Amphiporidae	Amphiporus	Gen	2	0	2
Carinomella lactea	NMR	Palaeonemertea	Tubulaniformes	Carinomellidae	Carinomella	Spe	4	0	4
Cephalothrix spp	NMR	Palaeonemertea	Archinemertea	Cephalotrichidae	Cephalothrix	Gen	1	0	1
Cerebratulus spp	NMR	Pilidiophora	Heteronemertea	Lineidae	Cerebratulus	Gen	26	9	35
Hoplonemertea	NMR	Hoplonemertea				Cla	4	1	5
Lineidae (juv/dam)	NMR	Pilidiophora	Heteronemertea	Lineidae		Fam	3	0	3
Lineus sp (juv/dam)	NMR	Pilidiophora	Heteronemertea	Lineidae	Lineus	Gen	1	0	1
Lineus spp	NMR	Pilidiophora	Heteronemertea	Lineidae	Lineus	Gen	0	2	2
Nemertea	NMR					Phy	14	0	14
Palaeonemertea	NMR	Palaeonemertea				Cla	7	0	7
Phoronis spp	PHO			Phoronidae	Phoronis	Gen	0	8	8
Calcarea (juv/dam)	POR	Calcarea				Cla	1	0	1
Porifera (juv/dam)	POR					Phy	16	0	16
Priapulus caudatus	PRI		Priapulomorpha	Priapulidae	Priapulus	Spe	1	1	2

TABLE 7. F04 SUMMARY OF MACROFAUNA ABUNDANCE AND CALCULATED DIVERSITY INDECES. Total abundance is calculated from the raw counts multiplied by the fraction split for each OTU identified by Huntsman Marine Science Centre within a sample (range from 1/16 to 1/1).

Station	Distance from cages (m)	Total abundance (counts)	Species Richness (N_0)	Shannon Diversity (N_1)	Simpson Diversity (N_2)
56	0	5430	48	5.16	3.76
44	14	5832	36	5.96	3.96
58	21	1918	23	4.66	2.43
74	35	3808	52	6.08	3.45
67	54	6832	43	8.58	5.15
70	73	2460	66	6.67	2.33
71	74	3997	49	7.72	4.75
63	113	2182	55	4.26	2.42
61	130	5324	56	8.96	5.76
43	145	1580	57	11.04	5.90
52	154	3050	49	8.62	5.38
38	237	953	38	5.87	3.28
47	369	1774	41	7.09	3.58
37	370	9485	66	5.49	3.01
34	476	2630	60	10.14	5.38
28	558	3416	50	6.92	2.96
24	570	407	33	7.03	3.35
46	605	5159	70	12.10	5.18
41	613	4830	55	10.62	4.78
19	666	516	50	14.16	7.29
18	767	1643	46	7.95	4.31
11	831	6396	47	5.03	2.90
10	889	3928	62	7.90	3.02
14	916	4255	46	6.54	3.47
22	940	3350	86	9.55	3.72
7	967	4248	48	8.79	5.20
9	1013	1944	78	15.01	5.59
21	1070	4309	64	5.36	2.03
35	1159	367	93	53.41	32.28
33	1481	532	46	9.88	3.61

TABLE 8. F10 SUMMARY OF MACROFAUNA ABUNDANCE AND CALCULATED DIVERSITY INDECES. Total abundance is calculated from the raw counts multiplied by the fraction split for each OTU identified by Huntsman Marine Science Centre within a sample (range from 1/16 to 1/1).

Station	Distance from cages (m)	Total abundance (counts)	Species Richness (N_0)	Shannon Diversity (N_1)	Simpson Diversity (N_2)
1	0	2969	44	3.03	1.85
2	0	13308	61	6.84	3.30
4	10	5048	42	5.43	2.73
3	15	10182	41	5.19	3.60
11	40	4752	53	9.05	5.43
84	68	8312	41	4.69	2.66
12	79	6616	38	6.21	3.70
9	88	3416	57	8.01	3.58
8	102	685	51	19.07	8.53
10	104	9241	58	6.23	4.18
86	124	12070	46	7.74	4.53
14	152	5056	29	4.77	2.46
81	199	881	45	8.48	3.65
13	208	4585	47	7.85	4.07
68	222	15296	49	3.56	1.78
70	286	2680	22	8.61	5.08
71	307	5949	30	3.53	2.04
74	317	7068	29	6.02	4.51
63	320	4920	25	7.51	4.65
72	320	1378	28	1.92	1.37
73	326	2113	23	6.49	3.40
61	368	3656	31	9.75	6.70
77	421	14235	24	3.42	2.12
76	425	8047	30	6.34	3.98
62	445	5400	40	10.65	6.54
78	464	13136	19	4.47	3.05
60	481	9264	32	9.42	6.44
56	554	2475	23	5.38	3.31
57	581	1247	19	6.13	4.29
58	748	3944	19	7.20	4.98

APPENDIX II: DATA FIGURES

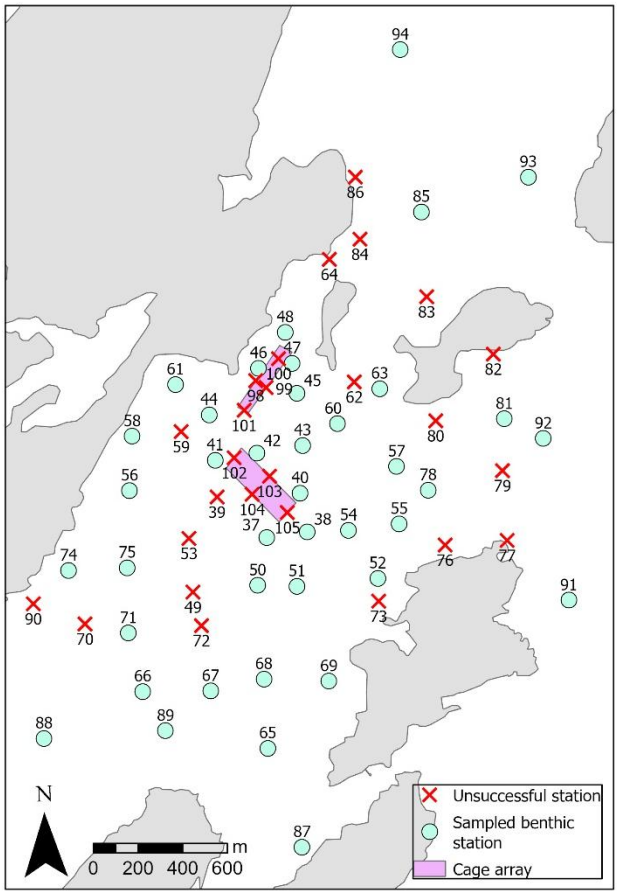

FIGURE 1. AMP MARITIMES BENTHIC SAMPLING AT SITE F09 IN 2024. Unsuccessful stations were a result of a lack of soft sediment, vessel and station inaccessibility as a result of original grid station being too close to shore or other boat traffic during sampling days.

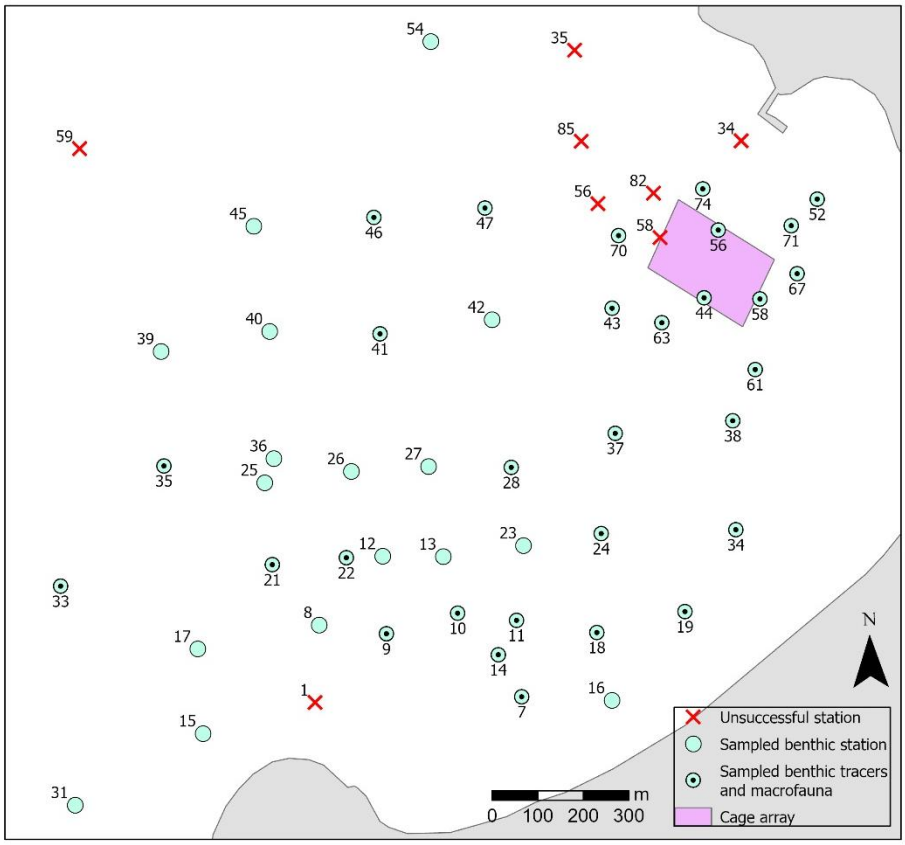

FIGURE 2. AMP MARITIMES BENTHIC SAMPLING AT SITE F04 IN 2024. Stations numbered >56 were new for 2024 as part of a spatial optimization and rebalancing of the original grid of stations established in 2019. Unsuccessful stations were the result of a lack of soft sediment.

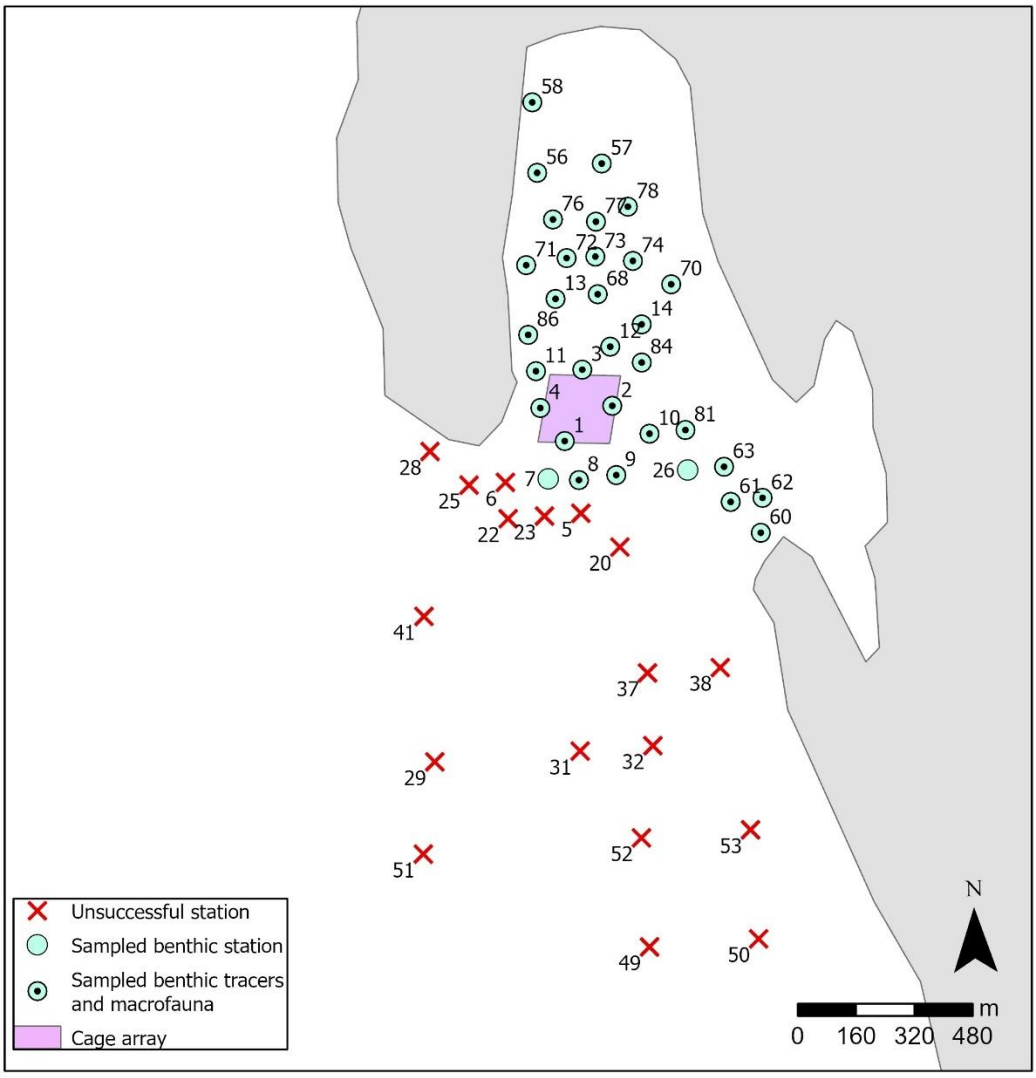

FIGURE 3. AMP MARITIMES BENTHIC SAMPLING AT SITE F10 IN 2024. Unsuccessful stations were the result of a lack of soft sediment.

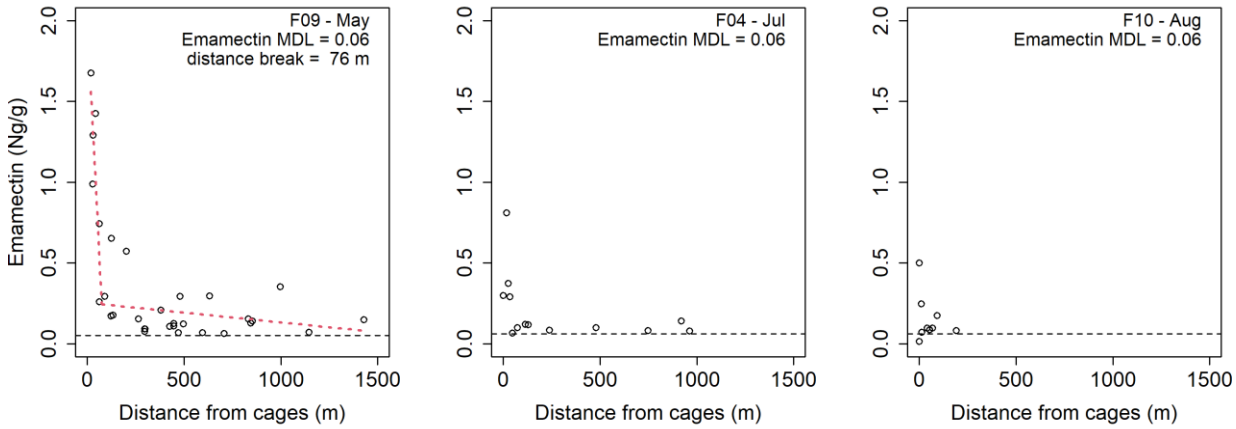

FIGURE 4. EMAMECTIN CONCENTRATION RELATIVE TO DISTANCE FROM TARGET FARM. Presence of a red dashed line indicates a significant distance breakpoint of Emamectin concentration as a function of distance away from the target farm (p<0.05). Black dashed line indicates the method detection limit reported by MB Labs for Emamectin (0.06 ng/g).

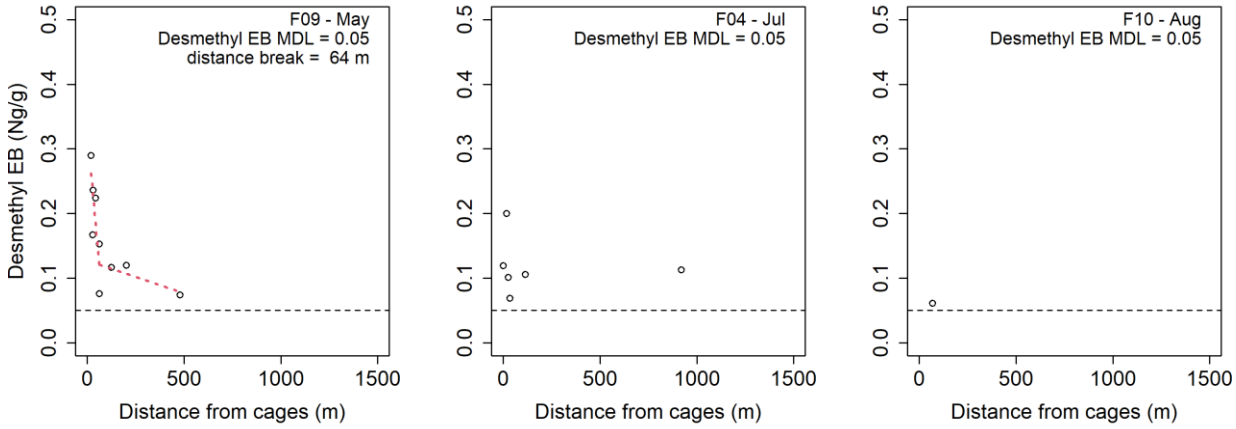

FIGURE 5. DESMETHYL EB CONCENTRATION RELATIVE TO DISTANCE FROM TARGET FARM. Presence of a red dashed line indicates a significant distance breakpoint of Desmethyl EB concentration as a function of distance away from the target farm (p<0.05). Black dashed line indicates the method detection limit reported by MB Labs for Desmethyl EB (0.05 ng/g).

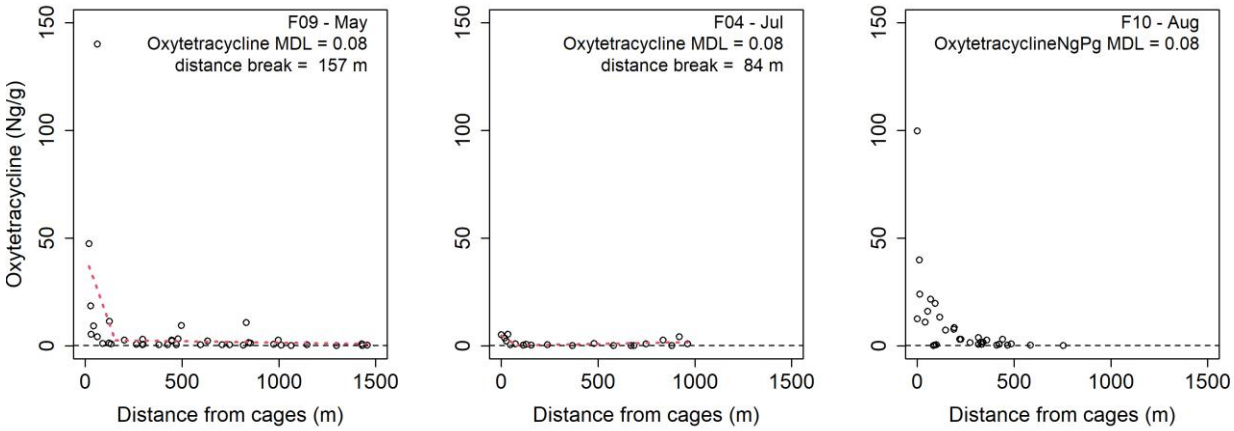

FIGURE 6. OXYTETRACYCLINE (OTC) CONCENTRATION RELATIVE TO DISTANCE FROM TARGET FARM. Presence of a red dashed line indicates a significant distance breakpoint in OTC concentration as a function of distance away from the farm cages (p<0.05). Black dashed line indicates the method detection limit reported by MB Lab for OTC (0.081 ng/g).

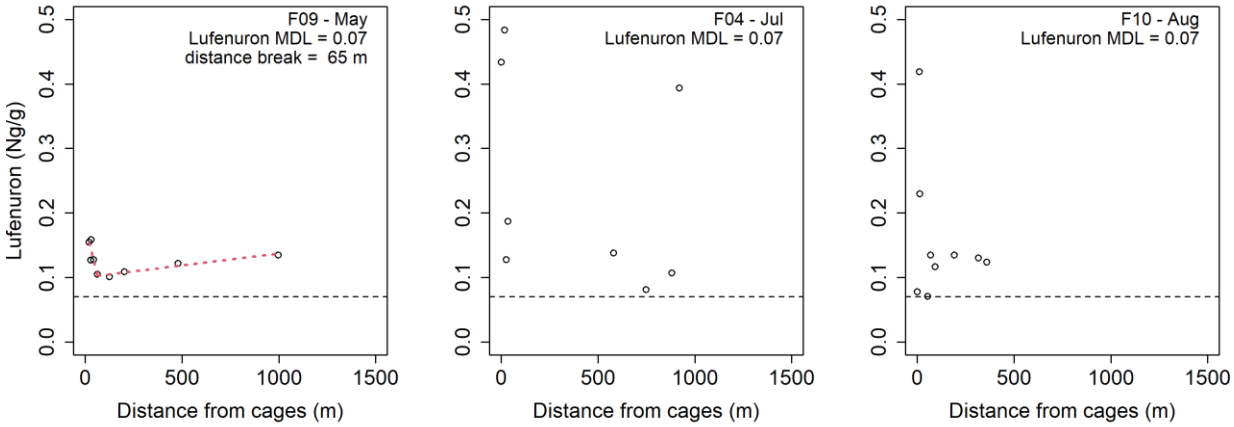

FIGURE 7. LUFENERON CONCENTRATION RELATIVE TO DISTANCE FROM TARGET FARM. Presence of a red dashed line indicates a significant distance breakpoint in Lufeneron as a function of distance away from the farm cages (p<0.05). Black dashed line indicates the method detection limit reported by MB Labs for Lufenuron (0.07 ng/g).

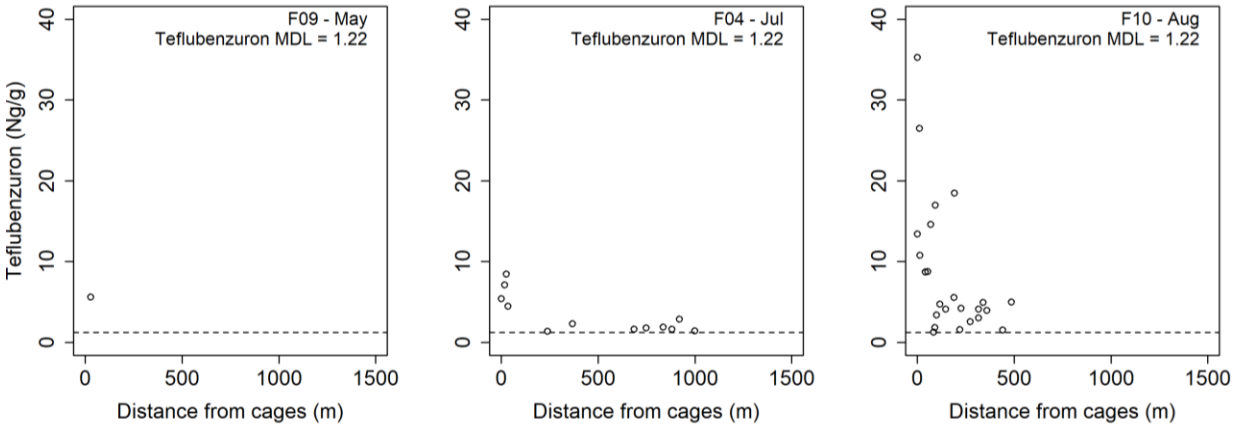

FIGURE 8. TEFLUBENZURON CONCENTRATION RELATIVE TO DISTANCE FROM TARGET FARM. Black-dashed line indicates the method detect limit reported by MB Labs for Teflubenzuron (1.22 ng/g).

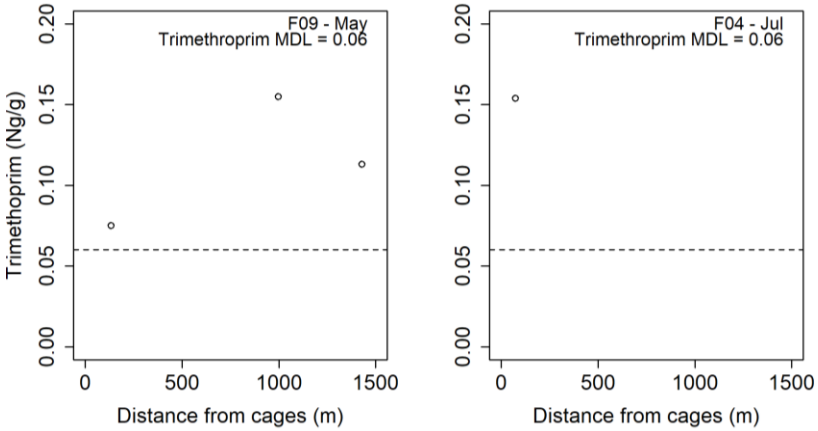

FIGURE 9. TRIMETHROPRIM CONCENTRATION RELATIVE TO DISTANCE FROM TARGET FARM. Trimethroprim was not detected in samples from F10. Black-dashed line indicates the method detection limit reported by MB Labs for Trimethroprim (0.06 ng/g).

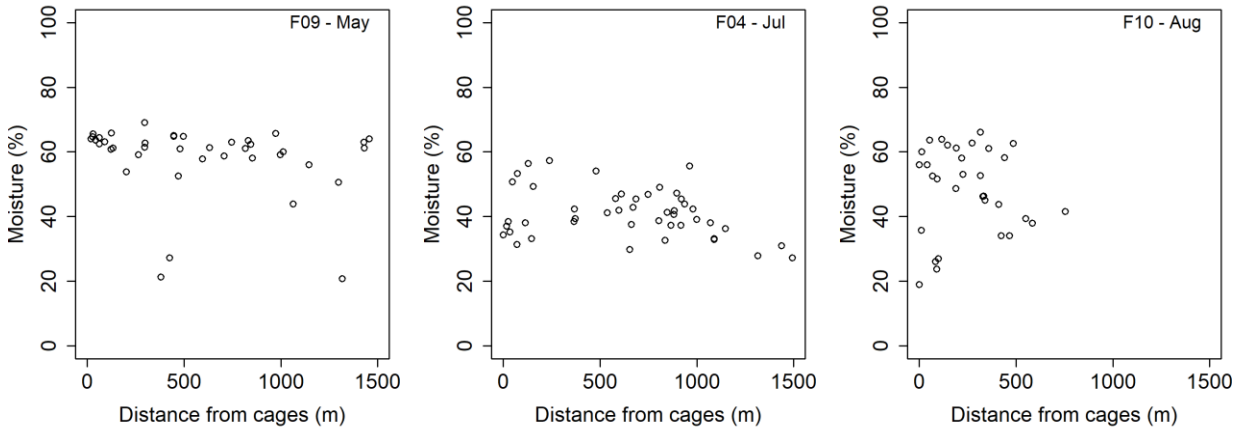

FIGURE 10. MOISTURE CONTENT OF BENTHIC SAMPLES RELATIVE TO DISTANCE FROM TARGET FARM.

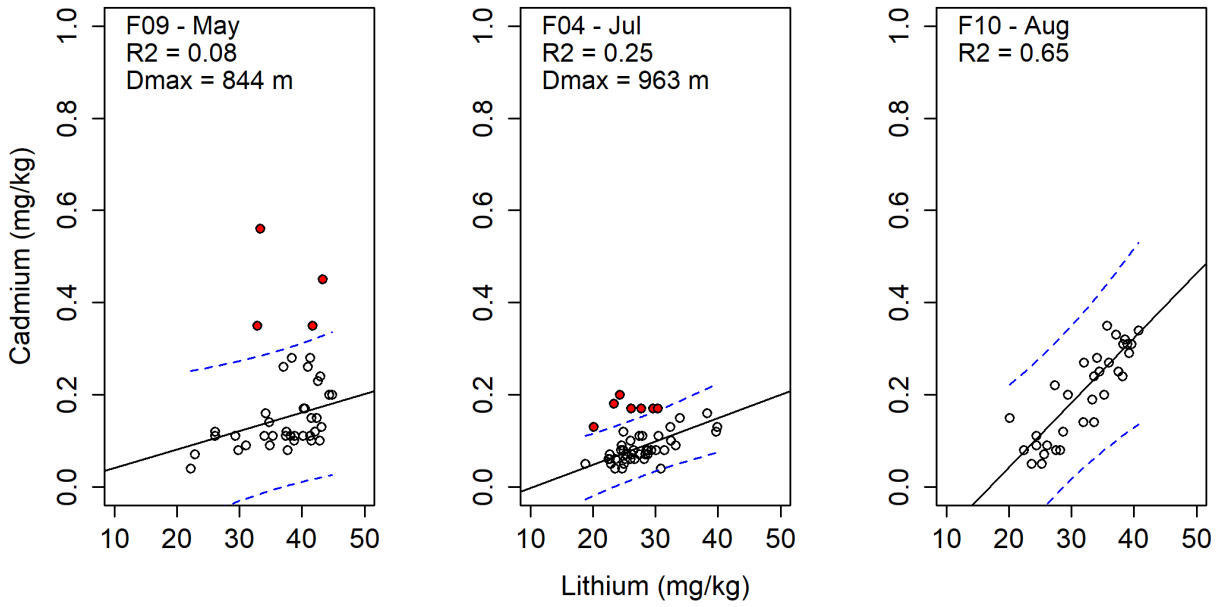

FIGURE 11. GEOCHEMICAL NORMALIZED CADMIUM LEVELS BY STATION. Enriched stations (solid red circles) plot above the 95% confidence interval (dashed-blue lines) from the normalization regression (black line) against Lithium. Dmax is the maximum distance an enriched station was located from the farm cages. Note the poor regression fit (R^2) of the normalization procedure for cadmium at some sites.

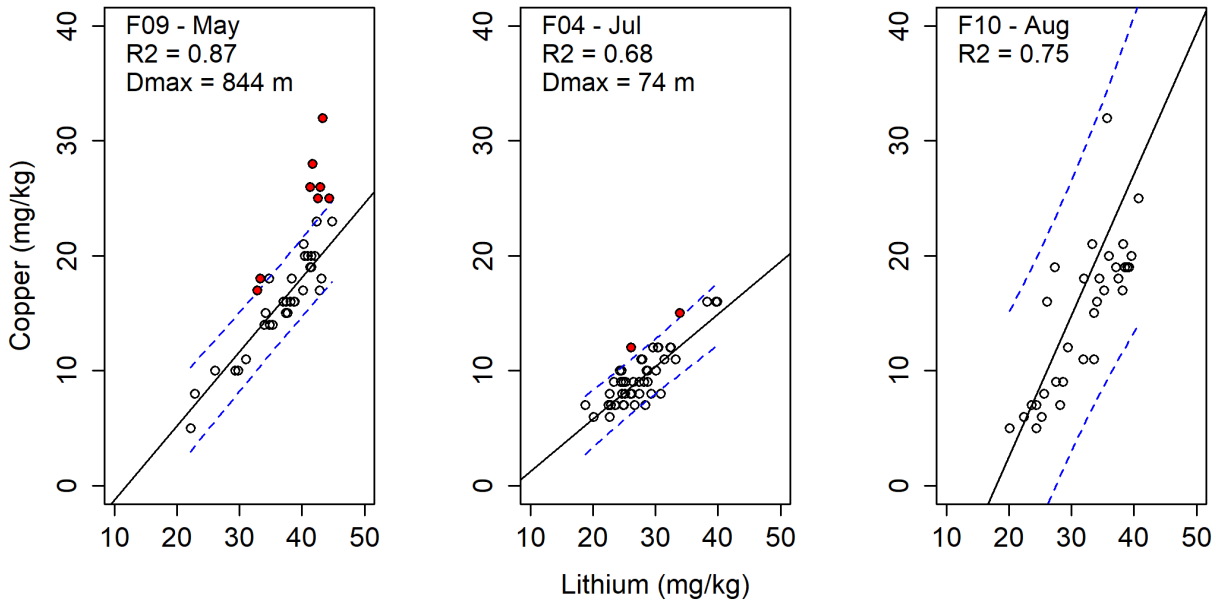

FIGURE 12. GEOCHEMICAL NORMALIZED COPPER LEVELS BY STATION. Enriched stations (solid red circles) plot above the 95% confidence interval (dashed-blue lines) from the normalization regression (black line) against Lithium. Dmax is the maximum distance an enriched station was located from the farm cages. Note the poor regression fit (R^2) of the normalization procedure for copper at some sites.

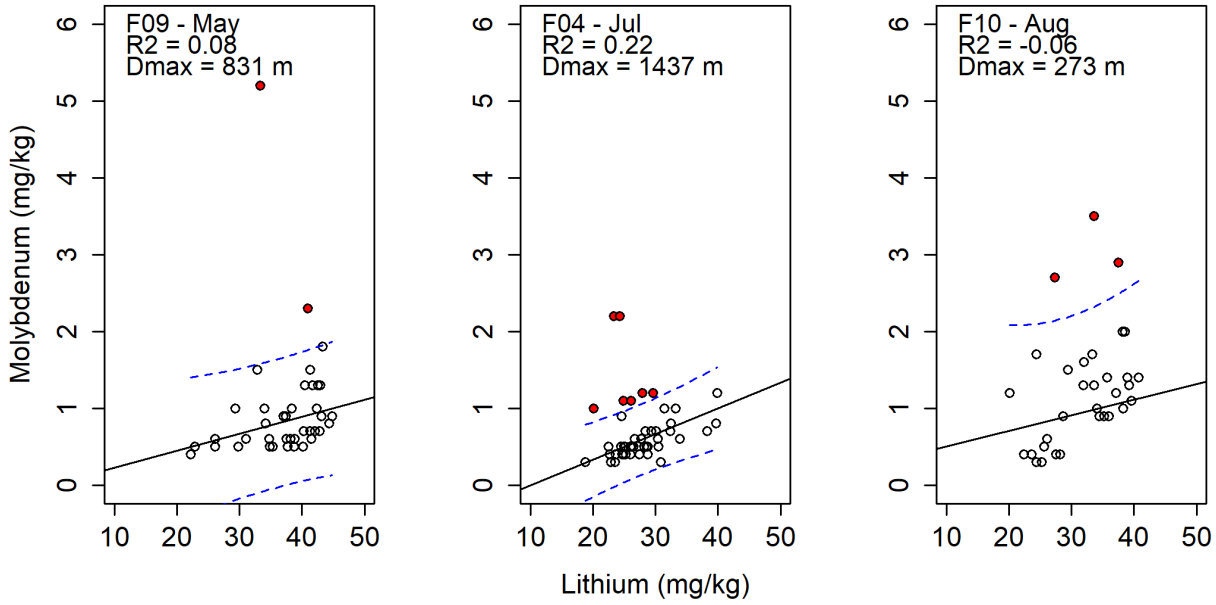

FIGURE 13. GEOCHEMICAL NORMALIZED MOLYBDENUM LEVELS BY STATION. Enriched stations (solid red circles) plot above the 95% confidence interval (dashed-blue lines) from the normalization regression (black line) against Lithium. Dmax is the maximum distance an enriched station was located from the farm cages. Note the poor regression fit (R^2) of the normalization procedure for molybdenum at sites.

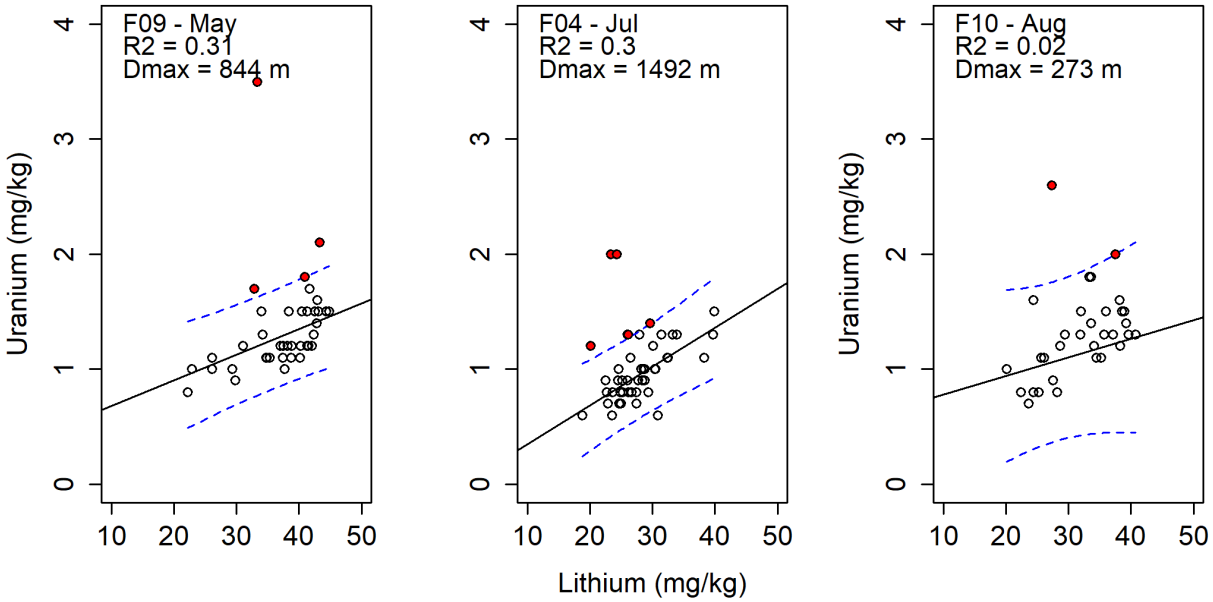

FIGURE 14. GEOCHEMICAL NORMALIZED URANIUM LEVELS BY STATION. Enriched stations (solid red circles) are above the 95% confidence interval (dashed-blue lines) from the normalization regression (black line) against Lithium. Dmax is the maximum distance an enriched station was located from the farm cages. Note the poor regression fit (R^2) of the normalization procedure for uranium at sites.

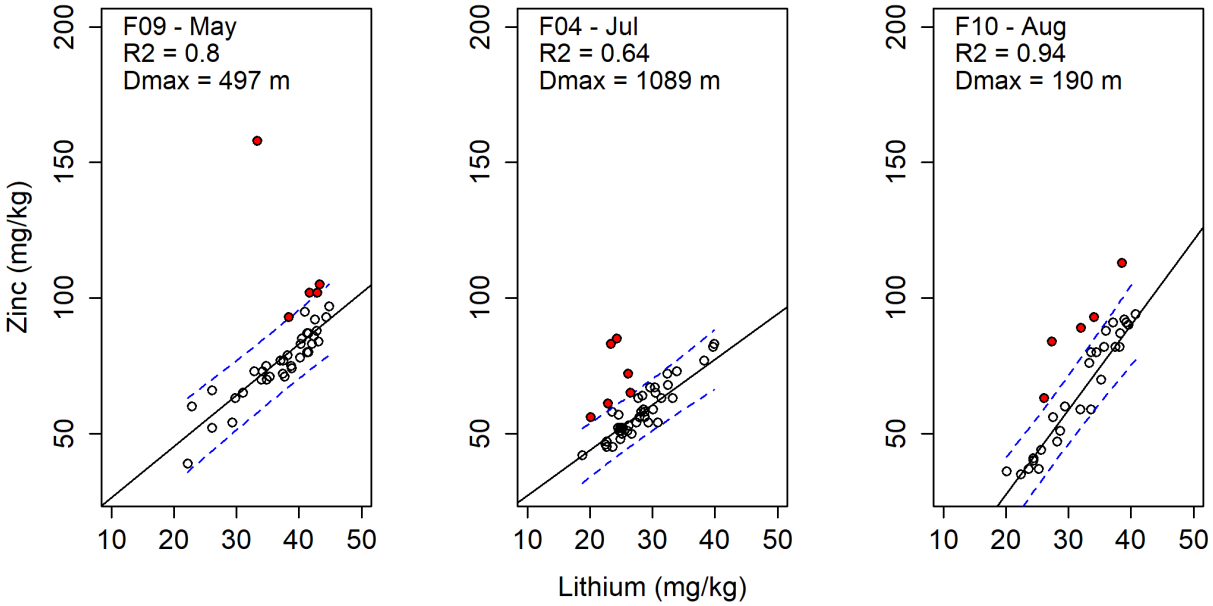

FIGURE 15. GEOCHEMICAL NORMALIZED ZINC LEVELS BY STATION. Enriched stations (solid red circles) plot above the 95% confidence interval (dashed-blue lines) from the normalization regression (black line) against Lithium. Dmax is the maximum distance an enriched station was located from the farm cages. Note the poor regression fit (R^2) of the normalization procedure for Zinc3 at some sites.

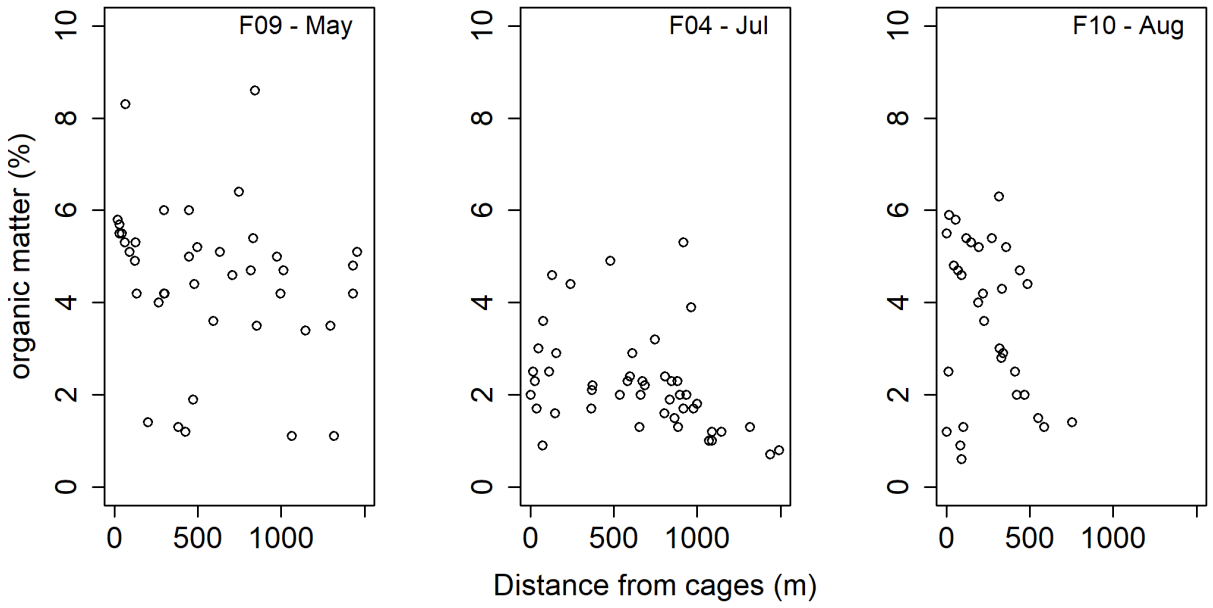

FIGURE 16. ORGANIC CONTENT RELATIVE TO DISTANCE FROM TARGET FARM.

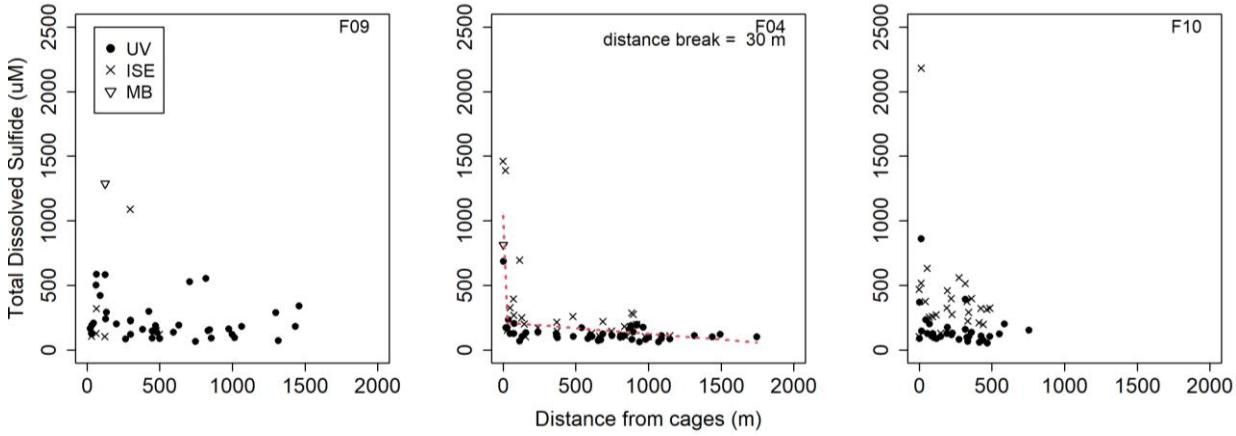

FIGURE 17. TOTAL DISSOLVED SULFIDE (TDS) AS A FUNCTION OF DISTANCE FROM TARGET FARM. Presence of a red dashed-line indicates a significant distance breakpoint as a function of distance away from the farm cages ($p<0.05$). Analysis of each site's data was performed using measurements pooled among the three methods (UV, ISE, MB).

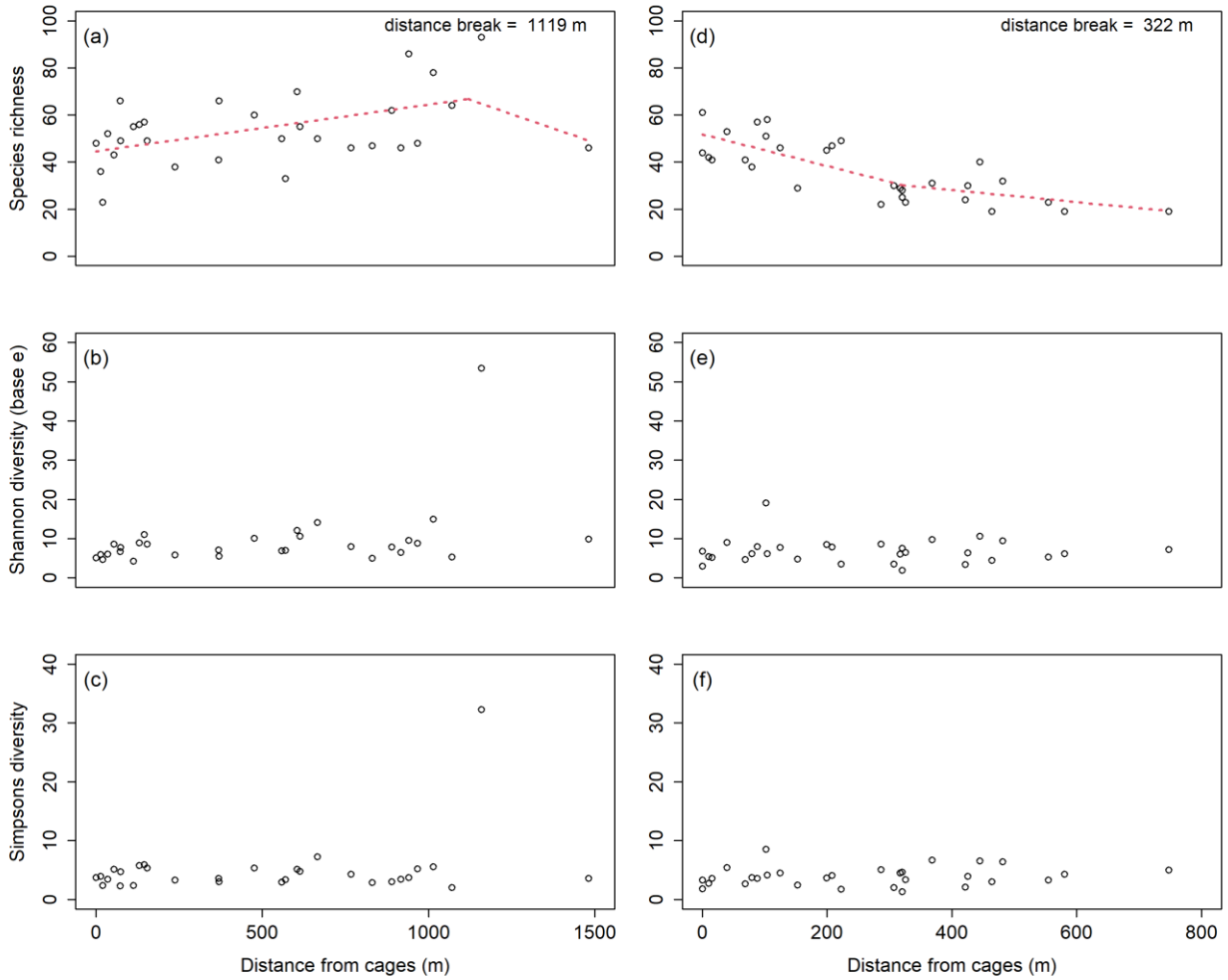

FIGURE 18. BIODIVERSITY INDICES AS A FUNCTION OF DISTANCE FROM TARGET FARM. Species richness, Shannon diversity (base e), and Simpsons diversity are calculated from samples collected at site F04 in July (a,b,c) and at site F10 in August (d,e,f). Presence of red dashed lines indicate a significant distance breakpoint for a given diversity index and site ($p<0.05$).

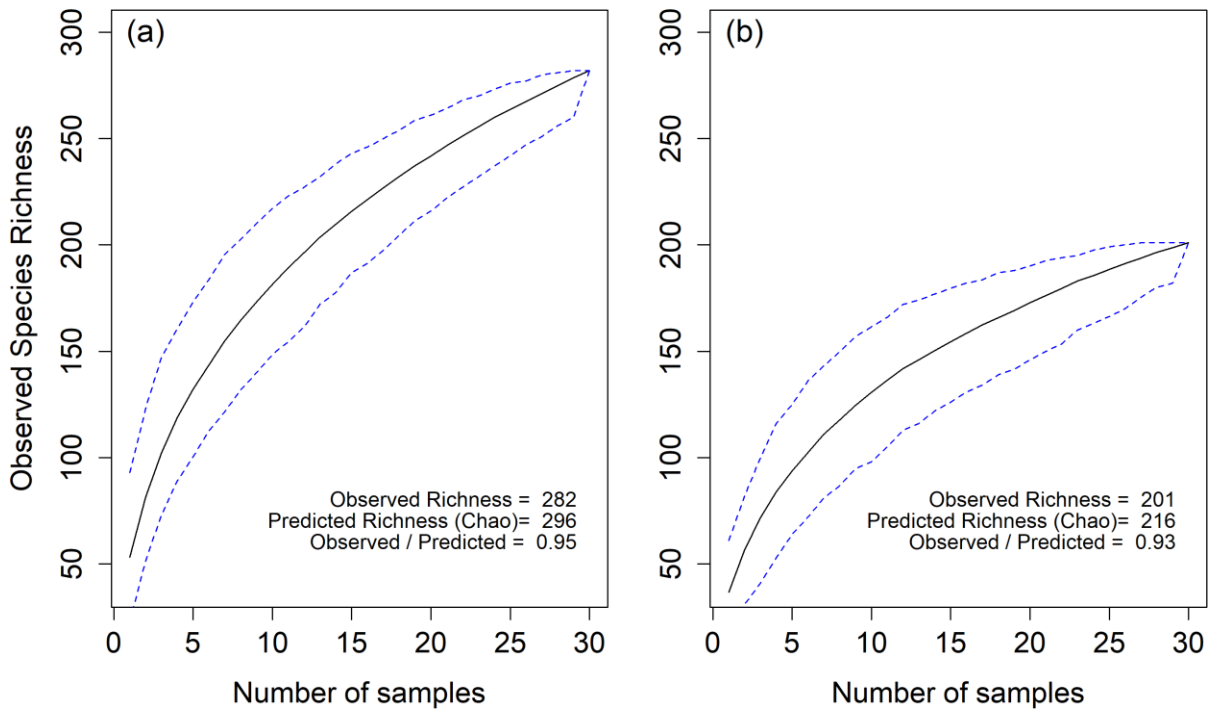

FIGURE 19. SPECIES ACCUMULATION CURVES FOR MACROFAUNA. Samples are from (a) site F04 in July (n=30 samples), and (b) site F10 in August (n=30 samples). Predicted richness was calculated using the Chao estimator on species abundance (count) data.